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An Asterisk (*) denotes an illustrated article.

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[OFFICIAL NOTICE.]

Twenty-first Annual Meeting, American Gas Light Association.

AMERICAN GAS LIGHT ASSOCIATION, OFFICE OF SECRETARY, PROVIDENCE, R. I., September 30th, 1893.

To all Members: The Twenty-first Annual Meeting of the American Gas Light Association will be held in Chicago, Ills., beginning October 18th, 1893. The headquarters will be at the Victoria Hotel. The meeting will be called to order at 10 o'clock, on the morning of Wednesday, October 18th, in Kinsley's Hall, 105 Adams street, by the President, A. E. Boardman.

The following papers will be read:

1. "The Revivification of Iron Oxide," by Geo. T. Thompson, St. Louis, Mo.
2. "Gas Engines in the United States," by Fred. H. Shelton, Philadelphia, Pa.
3. "Rate of Purification," by J. A. P. Crisfield, Savannah, Ga.
4. "Relation of Temperature to Purification," by Jas. Somerville, Indianapolis, Ind.

And two others are conditionally promised.

This year the questions submitted for the Question Box will be printed and sent out with the papers, so that if you have any queries to propose, send them to the Secretary *at once.*

The meetings of the Association will be held at Kinsley's Hall, No. 105 Adams street.

Special attention is directed to the Bulletin Board which will be placed in the lobby of the Victoria Hotel, as there will be some very important notices in regard to the meeting, which may be condensed into one day, in which case an evening session may be called.

Cards will be provided at the door for the members and visitors to register as they enter the meeting room for the *first* time, thereby obviating the necessity for the roll call. Name and post office address to be written on the card, which will be taken up by the doorkeeper.

The Committee of Arrangements not having yet reported the details of their work, the Secretary is unable to announce their programme.

Hotel accommodations must be applied for at once by those who have not already secured them. The Victoria will accommodate 50 at $2.50 per day and upwards, and in the immediate neighborhood of the hall are the following, which can accommodate as follows:

Great Northern	25	guests at	$2.00	per day	and	upwards.
Gore's Hotel...	25	"	1.75	"	"	"
McCoy's " ...	75	"	1.75	"	"	"
Saratoga " ...	75	"	1.50	"	"	"

These, like the Victoria, are all on the European plan. The Grand Pacific Hotel can take at most 150 at from $5 per day up, on the American plan, while a few may go to the Auditorium Hotel at from $8 a day up. Accommodations may also be had near the Fair grounds, in good hotels too numerous to specify.

Those New England members who desire to make up a special car or cars, should notify the Secretary at once how many seats they will take, and he will advise them as to prices, accommodations, etc., as much depends on how many tickets will be taken. If an insufficient number respond, no special car will be provided, and those who do write will then be so notified.

As by the Constitution all dues are payable in advance, your bill is inclosed herewith, and if you will remit immediately, payable to A. B. Slater, Jr., Treasurer, you will help much toward relieving that unfortunate official of the rush which always taxes him severely at the meetings.

The Secretary especially calls the attention of those members whom it may concern to the fact that, in accordance with the Constitution, all members whose dues remain unpaid for a term of three years, will be dropped from the rolls.

All applications must be in the Secretary's hands by October 8th, to be acted on at this meeting.

Respectfully, A. B. SLATER, JR., Secretary.

[OFFICIAL NOTICE.]

Call for Council Meeting.

AMERICAN GAS LIGHT ASSOCIATION, OFFICE OF SECRETARY, PROVIDENCE, R. I., September 30th, 1893.

To the Members of the Council: There will be a meeting of the Council of this Association in the Victoria Hotel, Chicago, Ills., at 7

P.M. sharp on October 17th, 1893, for the transaction of the usual and such other business as may be brought before it.

Respectfully, A. B. SLATER, JR., Secretary.

BRIEFLY TOLD.

THIS WEEK, AT CHICAGO.—Everything has been virtually arranged for the meeting in Chicago this week of the American Association, and so well have the details been attended to that those who will participate in the convention need have no fear of the occurring of any hitch to interrupt the even motion of their way. Four papers will certainly be presented, with the likelihood that the two "conditionally promised" will also be read and discussed, and the Question Box can be confidently counted on to furnish a goodly number of interesting themes. As it seems now, President Boardman will have the satisfaction of presiding over a meeting that is to be strong in point of numbers, for the members in this section are not slow in passing the expression, "Of course, I'll see you in Chicago at the meeting." The local Committee of Arrangements have determined to have the banquet this year strictly in accordance with the views of those who hold that it is preferable not to participate in any hospitality of this sort unless the cost thereof is borne by those who share in the same. With that understanding it has been arranged that the banquet will be held in Kinsley's on the evening of the 18th, the tickets for which are on sale at $5 each. The committee are to be congratulated on having the courage to carry out strictly the resolution in this respect adopted on the occasion of the Savannah meeting, and it will be a downright, good, practical test of the real popularity of such a measure. We presume that all who propose attending the sessions have seen to it that their hotel accommodations have been secured well in advance.

THE PHILADELPHIA GAS RATE.—The City Councils and the other municipal authorities of Philadelphia concerned in the attempt to put the gas rate of that city at a figure which will bear something like closer relation to the value of the article paid for than the ruling price can be fairly said to do, are floundering badly in their initial trying. Each Councilman seems to have a figure of his own that he deems would best meet the exigencies of the situation, and, of course, each of these experimenters has a set argument in proof that he alone offers the solution of that which all concede is a knotty problem at best. Rates of $1.25, $1.20, $1.10 and $1 have been proposed, and while many queer supporting statements have been advanced in favor of each of the named rates, we think it was reserved for Mr. McMurray (who suggested the $1.20 charge) to outdistance his colleagues in respect of backing-up his adjustment by the oddity of the cause which he offers for so deciding. He admits that gas is too dear in the Quaker City, and that $1.25 would be far nearer the mark as a proper charge than $1.50; yet he would substitute $1.20 per 1,000 for both, simply because that the computing of the rate at his figure would save the clerks in the gas bureau a vast deal of trouble and labor in keeping their accounts. It is so much "harder," you know, to be a "gas clerk mathematician," when one has to charge up an account in quarters instead of fifths! We venture to say that no one other than a Philadelphia Councilman would have thought of this weighty objection. However, the residents of the city may congratulate themselves that all this discussion and agitation of the gas question is reasonably certain to result in a benefit to themselves, in the shape of a cut, of one sort or another, in the rate; and it is to be hoped, if Councilman McMurray is unable to convince his colleagues that fifths are easier of computation than quarters, that his deep solicitude for the gas clerks will not lead him to oppose the proposed $1.25 price.

THE RESIGNATION OF COMMISSIONER MCDONALD.—In our item columns will be found the news that Mr. James W. McDonald, Chairman of the Massachusetts Board of Gas and Electric Light Commissioners, has resigned therefrom. It is said Mr. McDonald desires to resume the active practice of his profession, which is that of the law; but we imagine that the real impelling motive is dissatisfaction with the duties and salary of the office that he resigns. He has acted as a Commissioner for perhaps one year, and during that time the Commissioners have been called upon to adjudicate many important and delicate cases. This means close attention and much worry, both far out of proportion in respect of the monetary requital allotted by the State for such services, as instanced in the salaries of the Commissioners. Mr. McDonald has made an excellent Commissioner, and he retires from the Board with the esteem of his colleagues and the respect of those with whom his official relations brought him in contact, irrespective of the capacity held by them, either as gas company or gas consumer.

On Flame.

[A lecture delivered by Prof. Smithells at the Nottingham meeting of the British Association.]

The lecturer began by saying that the first accurate knowledge of the nature of flame seemed to have been gained about the beginning of the Seventeenth Century. After alluding to the mystery which in ancient times had surrounded the subject, he remarked that the recognition of flame as being essentially burning gas was due to Van Helmont, who lived about 1600. Hooke, half a century later, gave a more complete account of flame, and especially of the part played by the air in promoting combustion. The exact chemical nature of the process was only arrived at by Lavoisier at the end of last century. The next important step in the history of the subject brought us to the memorable researches of Humphrey Davy. He recognized the connection between flame and explosion—a relationship which the lecturer illustrated by experiments, and which showed that flame might be regarded as a "tethered" and continuous gaseous explosion.

Dealing next with the Bunsen burner, Professor Smithells showed that the feebly luminous flame produced by it was, in reality, separable into two parts. Using a Bunsen burner with a long glass tube, instead of a short metal one, he demonstrated that, by increasing the amount of air added to the gas before combustion, the inner cone of the flame separated from the outer one, and descended the glass tube. All the air entering the tube was used in the first flame; and the excess of gas formed a second flame on reaching the free air at the top of the tube. By careful adjustment, the movable cone of flame was made to take up any desired position. He then showed that the two parts of the flame could be fixed apart from one another by slightly constricting the glass tube at one point; also that, when the inner cone was about to descend into the tube, it could be brought down by thrusting a glass rod vertically up the tube till it touched the cone. On pulling down the rod, the cone became inverted, and then followed the rod. A more convenient appliance was found in two tubes of different diameter—one sliding within the other. By means of this, the inner cone was obtained on the inner tube, and the outer cone on the outer tube; and the flame could be dissected or reconstructed at will. The inner cone was proved to be much hotter than the outer cone. When the fine dust of a salt of copper was introduced into the gas, it was seen that the green coloration was confined to the outer cone, and depended on the existence of the oxide of copper, which was impossible in the inner cone.

Proceeding to consider in detail the structure of flame, the lecturer showed that the simplest flame—such as that of hydrogen or carbon monoxide—consists of a single hollow cone of flame. Whether the light of the flame was due to the mere degree of heat of the gases or to something in the nature of atomic electrical discharge, was, he said, a moot point on which we should probably learn more before long. Dealing next with a gas which might burn in two chemical steps, Professor Smithells showed that, in the flame of cyanogen, the red inner part was due mainly to the formation of carbon monoxide, and the outer one to this carbon monoxide burning to form carbon dioxide. This was proved by the use of the flame-dissecting apparatus.

Proceeding to ordinary flames produced by hydrocarbons, or mixtures of hydrocarbons, he demonstrated the existence of three distinct parts, all of which were thin sheaths—first, a bright blue part, visible at the base of the flame; secondly, the bright yellow part; and, thirdly, a faintly luminous lilac mantle investing the whole flame. The development of these parts of flames was shown by means of a series of lantern slides made from actual photographs. In a very small flame the blue and lilac parts were seen as complete cones; in a somewhat larger flame the blue cone was interrupted by the appearance of a yellow patch; and as the flame was enlarged this patch rapidly overshadowed the other parts, both by its brilliancy and extent. It was next shown that the blue and lilac parts of the ordinary luminous flame correspond to the two cones of flame produced by a Bunsen burner. The chemical changes taking place in these two cones were next discussed; and it was demonstrated that, when the gas is starved of oxygen, it is the hydrogen and not the carbon that is left unburned. The products from the inner cone of a Bunsen flame, or the blue cone of an ordinary luminous flame, contain free hydrogen and carbon monoxide; and these gases pass on to burn in the outer cone of the Bunsen flame, or the lilac mantle of an ordinary flame.

The production of the luminous yellow part of flames was next discussed; and Davy's experiments with wire gauze, which led him to the conclusion that the luminosity was due to the separation of solid carbon, were repeated. After referring to Dr. E. Frankland's experiments on

the luminosity of flame, the lecturer said that Davy's theory still held its ground, though he believed Dr. Frankland had not yet said his last word. Alluding to the mode in which the carbon is separated in flames, the lecturer said that Davy had often been supposed to imply that the separation was due to a deficiency of oxygen in the middle of the flame, which led to the competition between the hydrogen and the carbon—the former having the advantage. This was not justified by Davy's words; and, at any rate, it was opposed to established facts. The cause of the separation of the carbon was to be sought in the intense heat produced by the combustion in the blue and lilac parts of the flame. The hydrocarbons within, being thus roasted, deposited carbon just as they did when they were passed through hot tubes. The theory of luminous flames advocated by the lecturer was epitomized in an experiment with benzine vapor burnt in the flame dissecting apparatus. The benzine could be burnt in a single cone of pale flame if much air were previously mixed with it, and in two cones if rather less air were added. If still less air was added, carbon separation began in the center of the flame, even while the cones were still separated.

In conclusion, Professor Smithells said that in past ages the earth had in all probability been the scene of flames of colossal proportions. It was known to be a cooling body, and also an oxidized body. At one time it must have been too hot for the oceans to have existed in a liquid state; and at a still more remote period, all the waters of the earth probably existed as an enormous gaseous envelope of uncombined hydrogen and oxygen. It was a chemical necessity to imagine an intervening time at which this hydrogen and oxygen would begin to combine. In this way it was not improbable that huge cosmical flames would rend the atmosphere. The steam formed, descending to the hotter strata of this pregeologic atmosphere, would be dissociated and sent forth again. In like manner many other oxidized compounds now constituting the outer crust of the earth would at one time be existing as uncombined gaseous elements in the atmosphere. For untold years, when the earth was still a glowing ball, it must have had a vast atmosphere, which was, in all probability, the scene of incessant celestial pyrotechny. It was startling to think how much the earth at that time must have resembled the sun, as the solar physicists know it at the present time. It was rash to hint at such a thing, but, if oxygen could be found in anything like abundance round the sun, there might be some cause to imagine that it not only looked like the fiery earth of bygone days, but had much in common with its chemical history. The chemical theory of the sun's heat had long since been disproved, and ordinary laboratory chemistry banished it from that luminary as altogether unsuited to its temperature. But one might be excused for expressing surprise, in view of the unity of plan in which heavenly bodies "move and have their being," that the sun should not exhibit the possession of a fair share of oxygen—the element which had ruled the earth's chemistry throughout all geological times and long precedent ages of its evolution.

[Continued from page 478.]

Gas Consumption.

[From "Series of Articles for Gas Students," in the London *Journal*.]

II.—*Conditions Favorable to Perfect Combustion, and their Application to Burner Construction.*]

"The intensity of light from flame depends principally upon the production and ignition of solid matter in combustion." This theory of the luminosity of flames was propounded by Sir Humphrey Davy as far back as 1817. It has been repeatedly assailed by eminent investigators, whose researches, however—while proving conclusively that certain factors (such as the density of the atmosphere surrounding the flame, the temperature of the latter, and other like conditions) have an important bearing upon its luminosity—have completely failed to shake the original theory.

For the development of light in an ordinary gas flame, the presence of solid matter in combustion is therefore essential. Hence, then, the necessity for so disposing the flame as that the hydrogen shall burn first, and by the heat thereby generated decompose the hydrocarbons, and raise the solid particles to incandescence prior to combustion. The experiments above referred to show that the higher the temperature of the flame, also the greater the density of the surrounding atmosphere, the higher will be the illuminating power, and vice versa. "The difference of an inch in the barometric column makes 5 per cent. difference in the luminosity. A burner giving 100 units of light with the barometer at 30 inches, would only give 95 units if it fell to 29; while a rise to 31 inches would mean an increase of the luminosity to 105 units" (Lewes.) Then, again, moisture in the air will prejudicially affect the light. Excessive pressure of gas at the burner tip is a certain preventive of perfect combustion. In such case much of the gas is rushed through the flame, and into the surrounding atmosphere, only partially decomposed—much less completely oxidized—with the production of acetylene and carbonic oxide, both of which gases are highly injurious to animal life. As already noticed, the presence of air in the flame tends to reduce its luminosity, and this whether the air be admitted to the interior or simply brought into contact with the flame. An apt illustration will be found in the soot and smoke produced by wind, or gusts of air, on the ordinary naked flat gas flames used in open shops, etc. The liberated carbon is so cooled by the gusts of wind as to be below the temperature at which it can combine with the oxygen of the air; hence a steady, regular and sufficient, but not an excessive supply of air, is a desideratum in economical and satisfactory coal gas consumption. Another consideration is the removal of products of combustion. To a certain extent this is effected by the light itself, in the upward currents of air set up by the heat and heated vapors of the flame. If these be not properly carried away, however, the air will become vitiated, and (not to speak of the depressing and injurious effect on human kind) the luminosity of the light will soon be materially reduced. Of course, this condition obtains more than ever with inclosed lights, as of the regenerative types. The injurious effects on the light of carbonic acid and water vapor have already been noted.

Lastly, as in most chemical operations, the perfection of coal gas combustion is enhanced by not being hurried. A well-formed flame—with just sufficient pressure of gas to enable it to retain its form perfectly—carefully shielded from draughts and an undue supply of air, and allowed to burn quietly at the rate at which the burner orifice will readily pass the gas, will give the best results. There is a point at which all burners will give their best results. Exceed this, and the rush of gas prevents complete combustion, and also draws air with it, to the detriment of luminosity. If the rate of consumption be not equal to the capacity of the burner, the flame becomes sluggish, irregular in shape, and jumps; and, not setting up a sufficient draught of air around, the gas is not properly consumed, and the flame smokes. As Mr. R. H. Patterson put it in the article on "Gas Burners" in "King's Treatise," Vol. III.: "It may be stated, as a general rule—in the case of argands with absolute correctness—that, however widely burners differ as regards the amount of light which they give from gas, every burner gives its *own* maximum of light per foot of gas just at the point, or rate of consumption, when its flame is about to smoke."

From the foregoing, it will now be seen that, in the construction of a good lighting burner, the following conditions must be observed and provided for: (1) Complete combustion of the gas; (2) the maintenance of a high temperature of combustion; (3) a careful regulation of the gas supply to the capacity of the burner; (4) the same as regards the air supply, and prevention of draughts, etc., to the flame; and (5) efficient ventilation.

It may be convenient at this point, before applying the principles above enunciated to burner construction, to note the three types of illuminating flames in general use. These are the flat flame, as produced from the well known batswing or slit burner and the fishtail or union jet burner; the argand, and that produced in the ordinary form of regenerative lamp, which is practically a form of argand flame. The incandescent burner is beyond the scope of the present remarks, insomuch that the light produced is not obtained (except indirectly) from coal gas. The latter, burning with a non-luminous bunsen flame, raises to incandescence a foreign substance, which latter is the direct luminant. This substance is woven in delicate threads into a "mantle," under which the bunsen flame burns. The light that is afforded by the lamp is effective and pleasing.

With ordinary coal gas, the argand flame gives a higher candle power per foot of gas consumed than the flat flame, whether from fishtail or batswing burner; but the reverse is the case with cannel gas of from 20-candle power upwards. It will be observed that the flat flame, being totally unprotected, is much more sensitive to any slight variations of atmospheric conditions on passing currents of air—any malformation of the proper shape of flame being also a certain indication of some interference with perfect combustion; whereas the argand flame is not only protected from these disturbing influences, but we have in the chimney a means of adjusting the air supply to a nicety, according to the requirements of the consumption and the quality of the gas.

Now with reference to the principles of burner construction. The first of the five conditions above named is really dependent upon the due observance of the third, fourth, and fifth. The second one is to be considered in a twofold sense—directly and indirectly. First, indirectly by the avoidance of every condition that may tend to reduce the flame

temperature. In this category is the class of burner utilized. A metallic burner being a good conductor, will convey heat downwards almost as fast as it is generated, and thus rob and cool the flame to an enormous extent. To this is attributable the extended area of the "dark central zone of the unburnt gases" where this type of burner is in use. Hence the introduction and adoption of adamas, steatite, and the other burner tips made of non conducting material. Then, again, an excessive pressure of gas at the burner tip, by causing the gas to draw with it currents of air which ultimately mix with it in the flame, considerably lowers the flame temperature; and it also produces a like effect in overburdening the flame, as it were, with a greater rush of cold gas than can be completely consumed. This condition is therefore (similarly to number one) subject to a proper observance of the third and fourth. Secondly and *directly*, by the employment of means calculated to increase the heat of the flame. The duplex burner was introduced with this object. The heat radiated from each flame helps to maintain the temperature of the other, and the air supply between the two flames is heated; so, theoretically, the twin flames give an illuminating power somewhat in excess of the sum of the two flames individually. On the other hand, however, it must be stated that each flame presents an obstacle to the passage of light from its fellow—the amount of light absorbed in passing through the wall of flame being computed at from 23 to 26 per cent. Moreover, the disadvantages attending the sensitiveness of flat flames to atmospheric disturbances, are simply doubled in this burner. The same applies in a less degree to the principal cause of the low service yielded by the flat flame—*i. e.*, the large surface of flame exposed to the cooling action of the air. The argand burner is much better fitted for the maintenance of a high flame temperature, as, being circular and self-contained, one part of the flame helps by radiation to keep up the temperature of that continuously adjoining. There are but two sides of the flame exposed to the air (and that heated air) instead of four, and no edges, as with flat flames; and the whole of the air supply is more or less heated, whilst the amount admitted can be regulated to the exact requirements by the length of the chimney. The loss of light by absorption through the circular wall of flame has to be taken into consideration with this burner also; and it is probably somewhat more than with the duplex. The modern regenerative lamp, however, carries this principle of high flame temperature much farther, and, in fact, almost (if not quite) to its utmost limit. This is effected by intensely heating both gas and air prior to their admission to the burner orifice, and the complete exclusion of cold air from the flame. The effect is an enormous increase of candle power per cubic foot of gas consumed. The construction of these burners is necessarily somewhat complicated and expensive; and hence the principle has been partially applied in another series of lamps, where the gas *only* is heated. These lamps, whilst giving very high results, do not, of course, attain to the duty of those just mentioned.

The three last mentioned conditions—viz., the proper regulation of gas and air supplies and the ventilation of the lamp—have already received attention—needless to say that, in the construction of the high class lamps above referred to, these points have to be most carefully considered. The matter of ventilation, however, often has to embody not only the removal of the products of combustion attending the lamp flame itself, but also the renewal of the atmosphere of the building in which the lamp is placed—vitiated, it may be, by the united exhalations of hundreds of human occupants below. The well known sun burner has done yeoman service in this connection. This burner also embodies the principle of heating the gas prior to combustion, as the supply pipes pass through the chamber above the lights, through which the whole of the heated products of combustion are passing away. The heat which necessarily attends the combustion of the gas, and the currents of air thereby set up, are utilized in the ventilating burners for carrying off the heated vapors from below; fresh air inlets being provided at suitable positions much lower in the hall—probably about 6 feet from the floor.

The following figures are from the fifth of the 1890 Cantor Lectures, already referred to. They clearly indicate the respective capabilities for developing light from the gas consumed, of the three types of burner named.

	Illuminating Power in Candles per Cubic Foot of Gas Consumed.	Products of Combustion per Candle Power.	
		CO_2	Water Vapor.
Batswing.....	2.9	0.18 c. ft.	0.46 c. ft.
Argand.....	3.3	0.16 "	0.4 "
Regenerative....	10.0	0.05 "	0.13 "

The next table shows the amount of oxygen used up, and the products of combustion formed, by each class of illuminant and burner, in illuminating a room (say) 16 ft. by 12 ft. by 10 ft. with (say) 20-candle power; and giving also the number of adults who would exhale the same amount during respiration.

	Materials Used. Grs.	Oxygen Removed. C. Ft.	Products of Combustion. Water Vapor. C. Ft.	Products of Combustion. CO_2 C. Ft.	Adults.
Sperm candles....	3,840	19.27	13.12	13.12	21.8
Paraffine oil.....	1,984	12.48	7.04	8.96	14.9
Gas (London).	C. Ft.	C. Ft.	C. Ft.	C. Ft.	
Batswing burner.	11.0	13.06	14.72	5.76	9 6
Argand " ..	9.7	11.52	12.80	5.12	8.5
Regenerative " ..	3.2	3.68	4.16	1.60	2 6

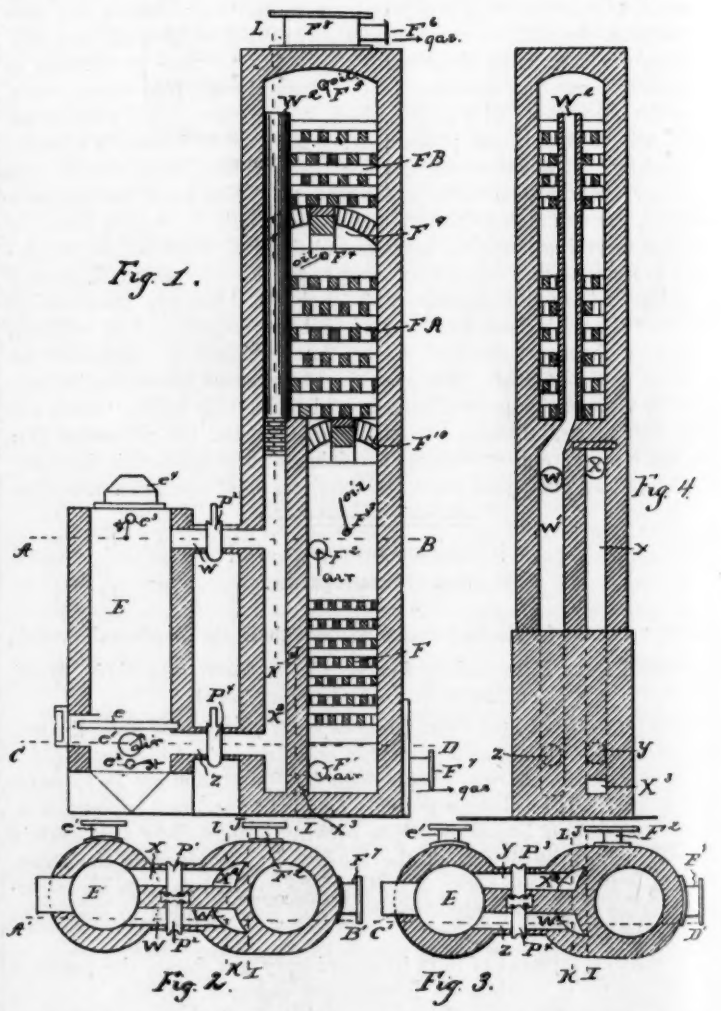
[To be continued.]

The Merrifield-Westcott-Pearson Improved Apparatus for Manufacturing Gas.

On September 26th, 1893, U. S. Letters Patent (No. 505,714) were granted to Messrs. Leonard L. Merrifield, of Franklin, Mass., John T. Westcott, of Cramer's Hill, N. J., and W. H. Pearson, Jr., of Toronto, Canada, for "a new and improved apparatus for manufacturing gas." Using the words of the specification:

Figure 1 is an elevation in section taken on line $A^1 B^1$ of Fig. 2—and $C^1 D^1$ of Fig. 3—of a water gas apparatus embodying our improvement. Fig. 2 is a cross section on line $A B$, Fig. 1. Fig. 3 is a cross section on line $C D$, Fig. 1. Fig. 4 is an elevation on lines $I J$ and $K L$, Figs. 1, 2 and 3.

Our invention relates to the construction of apparatus for the manufacture of water gas, and consists of combinations and constructions all



as will hereinafter be set forth in the specification and pointed out in the claim.

Referring to the drawings, E represents a generator provided with the usual grate e to support the fuel, e^1 an air blast conduit in the lower part of the generator, e^2 a steam inlet at bottom of generator, e^3 a steam inlet at top of generator, and e^4 a fuel inlet in the top of the generator. X and W are two outlets at top of generator; Y and Z are two outlets at bottom of generator. Each of these outlets X, Y, W and Z are provided with valves P^1, P^2, P^3, P^4.

X is a combustion fuel also used as a gas exit flue and having its rear

or exit end opening into a vertical flue X^2 in the wall of the superheaters. The upper end of flue X^2 is closed and the lower end is connected with the transverse flue X^3 that leads into the base of the superheating or fixing chambers.

W is a gas exit flue connecting with a vertical flue W^1 which extends from the bottom to the top of the shell of the superheating or fixing chambers.

Y is a gas exit flue connected with the flue X^2.

Z is a gas exit flue connected with the flue W^1.

F, $F\,A$ and $F\,B$ are superheating or fixing chambers containing refractory material placed in the form of checkerwork in the usual manner. It will be noted that the products of combustion do not directly enter the superheating or fixing chambers from the flues leading from the generator, but first enter the vertical flues W^1 and X^2, and then into the superheaters or fixing chambers. One of the objects in providing said vertical flues is to catch the dust and cinders before they can enter the superheater or fixing chambers and thereby avoid deposition of the dust and cinders upon the checkerwork and the subsequent clogging of the open work of the latter, as has been the case when the dust and cinders have not been intercepted before entering the superheating or fixing chamber. The dust and cinders so arrested fall to the bottom of the flues, from whence they are removed through suitably closed openings (not shown) at the bottom of the flues.

The superheating or fixing chambers F, $F\,A$ and $F\,B$, are contained in one single shell, and are separated from one another by divisional arches F^9 and F^{10}, having openings therein for the passage of the products of combustion from one chamber to the other. Below and above the checkerwork in chamber F are located respectively the openings of the air blast conduits F^1 and F^2. In each of the chambers are located the exit openings of oil supplying pipes—pipe F^3 being in chamber F, pipe F^4 in chamber $F\,A$, and pipe F^5 in chamber $F\,B$.

F^6 and F^7 are outlets for conveying the gas from the superheaters or fixing chambers to other parts of the works, and they or their pipe connections are provided with suitable valves (not shown) so that the gas, when occasion requires, can be diverted through one or the other of the outlets. Outlet F^6 is placed at the top and outlet F^7 at the bottom of the superheaters or fixing chambers so that they can be used in conjunction with the flues W^1 and X^2. When the flue X^2 is used, outlet F^7 is closed and the products of combustion are passed upward through the superheater or fixing chamber and through outlet F^6, and when flue W^1 is used, outlet F^6 is closed and the products of combustion are passed downward through the superheating or fixing chambers and through outlet F^7 for purposes hereinafter to be described. In the upper part of the superheater is an outlet pipe F^8 having a valve (not shown) which when opened allows the products of combustion to escape to the smoke stack for a purpose to be hereinafter described.

The operation of this apparatus is as follows: The fuel is introduced into the generator through the opening e^4, and the air blast is then introduced through opening e^1, and is forced through the fuel. The producer gas thus formed is allowed to pass through the conduit X, X^2 and X^3 to the superheaters or fixing chambers. Air is admitted through conduits F^1 and F^2 into said chambers, combustion is effected, and the chambers are heated. The products of combustion are allowed to escape through the valve in the top of pipe F^8 into the stack. When the fuel in the generator is sufficiently ignited and the refractory material in the superheaters and fixing chambers is sufficiently heated all the air blasts are shut off and the valve in pipe F^8 closed. Steam is then turned into the bottom of generator through pipe e^3, and passing through the ignited fuel is converted into water gas. The valves P^2, P^3 and P^4 having previously been closed, the water gas passes from the generator through the conduits X, X^2 and X^3 into the bottom of the superheater or fixing chamber F where it becomes highly superheated by passing through the refractory material with which the chamber is filled. Hydrocarbon vapors or liquids are then introduced through pipe F^3 into the chamber F, where they are instantly vaporized and diffused with the highly superheated water gas. Both gases then pass on through openings in arches F^9 and F^{10} into chambers $F\,A$ and $F\,B$, where the hydrocarbon vapors are gasified and fixed with the water gas, and which then pass on through the pipe or opening F^6 to the washers, scrubbers, condensers and purifiers. When the heat in the generator ceases to decompose the steam, the hydrocarbons and steam are then shut off, and the valve at outlet pipe F^8 opened; the air blast is then turned on at points e^1, F^1 and F^2, and the temperatures are raised as before described, and when the heats are sufficiently increased to again decompose the steam, the air blasts e^1, F^1 and F^2 are shut, valve P^4 is opened and valve P^1 is closed, and then outlet valve in outlet F^8 is closed. Steam is then introduced into the generator through pipe e^3, and which, passing down through the fuel, is converted into water gas. The water gas passes from the generator through the conduit Z into the conduit W^1, passes out at exit W^2, into the chamber $F\,B$, where it becomes highly heated by passing down through the heated refractory material with which the chamber is filled. Hydrocarbon vapors or liquids are then introduced into the chamber $F\,A$ through the pipe F^4, where they are instantly vaporized and diffused with the highly superheated water gas, then both gases pass on through the chambers $F\,A$ and F, where the hydrocarbon vapors are gasified and fixed with the water gas, and they then pass on through the outlet or opening F^7 into the washers, scrubbers, condensers and purifiers. When the heat in the generator ceases to decompose the steam, the hydrocarbons and the steam are then shut off and the valve in the outlet pipe F^8 is opened. Valve P^1 is also opened and valve P^4 is closed. If at this time, or at any other time, it is found necessary to replenish the fuel in the generator, it is done by introducing it through opening e^4. Opening e^4 being closed, the air blast is again introduced through the openings e^1, F^1 and F^2, and the temperatures raised as before described. When the temperature is sufficiently increased to again decompose steam, the valves of air blasts e^1, F^1 and F^2 are closed. The valve P^2 is now opened, and valve P^1 in flue X and in the outlet pipe F^8 are closed. Steam is introduced through pipe e^3, and passing through the fuel is converted into water gas. The water gas passes from the generator through the conduit W into flue W^1, and passes out at the exit W^2 into the chamber $F\,B$, where it becomes highly heated by passing down through the heated refractory material with which the chamber is filled. Hydrocarbon vapors or liquids are then introduced into the chamber $F\,A$ through the pipe F^4, where they are instantly vaporized and diffused with the highly superheated water gas. Both gases then pass on through the chambers $F\,A$ and F, where the hydrocarbon vapors or liquids are gasified and fixed with the water gas, and through the opening F^7 into the washers, scrubbers, condensers and purifiers. When the heat in the generator ceases to decompose the steam, the hydrocarbons and the steam are then shut off, and the valve in the outlet F^8 and valve P^1 are opened and the valve P^2 is closed. The temperatures raised as before described, until the heat being enough to decompose the steam, the air valves e^1, F^1 and F^2 are closed, and valve P^3 is opened; valve P^1 and the valve at outlet F^8 are then closed. Steam is now admitted through pipe e^3, and passing through the fuel is converted into water gas. The water gas passes from the generator through the conduit Y into conduits X^2 and X^3 into the bottom of the superheater or fixing chamber F, where it becomes highly superheated by passing through the refractory material. Hydrocarbon vapors or liquids are then introduced into the chamber through pipe F^3, where they are instantly vaporized and diffused with the highly superheated water gas. Both gases then pass on through the chambers $F\,A$ and $F\,B$, where the hydrocarbon vapors are gasified and fixed with the water gas, and through outlet F^6 to the washers, scrubbers, condensers and purifiers.

We do not limit our apparatus to be always operated in the exact order in which we have described it.

The changes may be varied as may be found most convenient at the discretion and judgment of the operator.

By providing four passages to connect the generator and the superheater, and two gas outlets in the superheater and at opposite ends, the apparatus may be utilized to obtain the best results in making gas. Some of the operations will now be described

Steam may be forced down through the fuel in the generator and the resultant water gas made to pass up from the bottom of the superheater to the top, or down from top to bottom. This requires two connections from generator to superheater. Steam may also be forced up through the fuel in the generator and the resultant water gas made to pass up from the bottom of the superheater to the top, or down from top to bottom. This requires two other connections, making four in all. In actual work it is found of very great advantage to be able at any moment to reverse the direction of the flow of gas through the superheater, because when the current has been continued for some time in one direction it is found that the part where the gas enters becomes of too low a temperature and the other end of too high a temperature for proper gas making, and by changing the direction of the current, the temperature is again made more uniform. When the temperature of any portion of the superheater chamber becomes too high the hydrocarbons or oils form lampblack, and when too low a temperature is formed in any part tar is deposited. It is possible to have tar, gas and lampblack all being produced at the same time in different parts of the superheating chambers. By having the double arrangement of ducts from top and bottom of generator, and apparatus arranged for reversing direction of the currents, the attendant may reverse the current in the generator without

changing that in the superheater, and may change the currents in the superheater without changing that in the generator. By frequently changing the current through the superheater a much more uniform temperature is maintained throughout the whole of the superheating chamber, and thereby a better and more uniform quality of gas is produced with much less waste of oil and with a saving in fuel.

Having now described our invention and the construction and operation of our apparatus for carrying into effect our new process, what we claim as our invention, and desire to secure by Letters Patent, is—

In an apparatus for making carbureted gas, the combination with a superheating chamber having a smoke exit, two sets of valve-controlled inlets and outlets in the top and bottom of said chamber, the inlet at the top being paired with the outlet at the bottom and the inlet at the bottom being paired with the outlet at the top; of a generator having two openings, one in the top and the other in the bottom, for the alternate admission of steam, and provided with a flue connection with the inlet at the top and a flue connection with the inlet at the bottom of said chamber, substantially as described.

Cost of Electrical Conductors.

At the meeting of the British Association a very interesting paper was read by Mr. Gisbert Kapp on the subject of "The Relative Cost of Conductors with Different Systems of Electric Power Transmission." He commenced by saying that it was just 20 years since the reversibility of the dynamo electric machine was discovered, and with it the electric transmission of mechanical power. The machines then, and until recently employed, were of the continuous current type; but within the last few years the transmission of power by alternating current apparatus has come into use, chiefly because by it the power could be carried to greater distances with a moderate weight of, and therefore moderate cost of, conductors. The reason for this economy was to be found in the fact that, owing to the absence of commutators and the facility and certainty with which the alternating current transformers can be insulated, the effective pressure at which the current is transmitted is much greater with alternating than with continuous currents. In other words, the author said, with continuous current plant the voltage is limited by the difficulty of insulating the generating machinery. With alternating current plant there is no necessity of high insulation of generator or motor, but only of the step-up and step-down transformers; and since this type of apparatus can, by the use of oil or other means, be insulated to any desired extent, it is the difficulty of insulating the line, rather than the machinery, which limits the voltage that can safely be employed. It followed that in comparing various systems of transmission as regards economy of material, all must be on the same basis by so designing the plant that there shall be in each the same stress on the insulation. The difference of potential, therefore, the author said, between any two points in the circuit, or between any point and earth, should not exceed a predetermined limit. The systems of transmission which have as yet been practically employed, and which, the author said, alone need claim attention, he had formulated in a table placed on the walls of the theater. They were as follows:

1. Single-phase alternating current transmitted by three wires.
2. Double-phase alternating current transmitted by four wires.
3. Double-phase alternating current transmitted by three wires.
4. Three-phase alternating current transmitted by three wires.
5. Continuous current transmitted by three wires.

Although the last case was practically impossible for extra high potentials, the author included it because it gave a convenient standard of comparison for the other four methods of transmission. It is well known that in any circuit, the different parts of which are equally well or equally badly insulated, the electrical center of gravity remains always at zero of potential, and the author pointed out that it followed from this axiom that if the circuit carry an alternating current, the absolute potential of any point undergoes a cyclic change, bringing it in turn above and below the potential of the earth by an equal amount. Thus, in a circuit carrying 10,000 effective volts, the greatest potential difference between two points would be about 14,000 volts, and the greatest possible value of the potential would be 7,000 volts, positive or negative. The insulation to earth would therefore be put under a stress not exceeeding 7,000 volts. If, however, one point on the line were earthed, the stress at other points would immediately rise to 14,000 volts.

Mr. Kapp next made a comparison between the continuous and single-phase alternating current as regards the weight of copper required for the line, assuming in both cases the same total power and the same efficiency of transmission. Fixing the greatest permissible stress at 7,000 volts from earth, the author said it would be immediately clear that the effective voltage of transmission in the case of the alternating current would be 10,000 volts, and in the case of the continuous current 14,000 volts; and since the weight of copper for equal efficiency conditions varies inversely as the square of the pressure, it followed that the transmission of power with alternating currents required twice as much copper as with continuous currents. With two phase currents and completely duplicated circuits (that is, four wires in the line), the same held good. This, the author said, would be obvious on consideration that each circuit carried half the power. Bunching two of the lines, however, altered the case. There would then be half the current in each of the external wires, and about 70 per cent. of the current in the middle wire. The apparent result would be a saving of copper. The author showed, however, that this saving was only apparent, for not only was there no saving of copper, but actually more copper was required than with the single-phase system or the four-wire double-phase system. The reason given for this was that if two of the terminals were tied together, the electrical center of gravity of each circuit was forcibly displaced, causing the potential of the other terminals to vary between wider limits. To keep the stress on the insulation down to a given limit, it is necessary to lower the voltage of each current, and this means that more copper must be used in the line. A similar investigation made by the author for the three-phase system showed that the effective voltage in each circuit must be lower than with a continuous current, but may be higher than with the single-phase alternating current.

Mr. Kapp said he did not propose to occupy the time of the meeting by giving the mathematical investigation of the various cases previously mentioned, but would simply state the practical result. If all the systems were placed on the same footing as regards efficiency and safety of insulation, it was found that, if for the transmission of a certain power over a given distance by continuous current 100 tons of copper are required for the line, then the single-phase alternating and the two phase four-wire system would require 200 tons, the two-phase three-wire system would require 290 tons, and the three phase three-wire system only 150 tons. As far as the line was concerned, there is thus, the author pointed out, a distinct advantage in the employment of the three-phase system. The author explained his meaning by means of mechanical models.

Gas Motors for Street Cars.

The *American Manufacturer* says that in several reports made by various authorities recently are given considerable information relative to the progress which has been made in Continental Europe in bringing gas motors into use for driving street cars; one a report by Herr Stucker, read before the last meeting of the Swiss Gas and Water Association, on the gas driven tram line between Neuchatel and St. Blaise. In that report, Herr Stucker says that Neuchatel has extended considerably along the shores of the lake, and tramways have become a necessity. In planning out the new line from Neuchatel to St. Blaise, the question of the choice of power came up for serious consideration. Horse power, electricity, and compressed air, all had their advocates; but all were too dear, and the decision arrived at was one in favor of the use of coal gas. Compressed air has the advantages of having no noise, no smoke, easy starting and stopping. It gives great satisfaction in Berne, on account of its quietness; but it costs there about 15 cents per car mile, although inexpensive hydraulic machines are used for compression. The line is also too expensive for any suburban district. Steam is somewhat less in its first cost than compressed air, but a locomotive has to be moved about as well as a car, and two persons are required for each machine, while the engines make much noise and smoke. From Weisbaden to Biebrich there run locomotives which are said to be free from these faults, but they cost $5,950 each. Steam roads pay when there are many passengers; not unless. Horse roads are cheap in first cost, but the current cost is high. None of these are particularly well adapted for a line on which the traffic is expected to be very small, say, 7 passengers per run. In the present case, the best means is the use of gas motors, using cylinders of gas compressed to 10 atmospheres, and containing enough gas to do the run out and home. The firm of Gillieron & Amrein, Vevay, undertook to supply the gas motors. They are strong, simple, practical, and safe, and free from noise and smoke; they only require a weekly cleaning. The starting and stopping are instant and free from shock. The weight of the car, with 20 passengers, 1 driver and 1 conductor, is about 6 tons. The distance is 3¼ miles, and the highest ground is half way, 40 feet higher than Neuchatel; 7.9-horse power are necessary to get up a speed of 11¼ miles an hour. If another car were hitched on, also fully loaded, the journey would take 27.4 minutes. The cost of gas,

with 1 car, would be, at $1.12 per 1,000 cubic feet, ½ cent per passenger and per journey, and with 2 cars it would be 22 cents.

A report to the Municipality of Nordhausen upon the gas driven street cars in use in Dresden, states that the gas is let in, at 6 atmospheres pressure, to permanent holders under the car. The gas is always admitted to the motor at the same pressure. The cooling water is in a tank at the top of the car, and it circulates naturally down to the cylinder when cool, and up to the roof when warmed. Herr Luhrig, the inventor of the car, finds this simple device very satisfactory as means of cooling the cylinder. Starting and stopping, even on heavy inclines, are quite easy and trustworthy. The report is decidedly in favor of the adoption of the new system by the town of Nordhausen, and points out that the durability of this system, as compared with that of an electric railway, is far greater. There are no wires to lay out upon a compression station. On the other hand, a gas car costs more than an electric one; say $5,000 each, while the Swiss ones, previously referred to, cost $3,000 each. An electric line pays when there is a big traffic; gas can run a small traffic. A gas car can go anywhere, and there may be few or many in use; electric cars are a good deal dependent upon one another, and upon the arrangement of the track for them.

Another report to the Nordhausen authorities gives the following as the advantages of gas cars over electric cars:

Much less first cost, since the gas company will undertake the supply of gas in a compressed state, and there is nothing farther necessary except a car shed; less current cost, since there are no central stations or conductors to keep up, and the outlay, apart from gas, which costs only 3 cents per mile, is limited to lubrication and cleaning material, repairs, upkeep of rails, wages and renewals, independent action of the cars, so that there cannot be a general breakdown; ease of making a small beginning, and extending as occasion offers; no consumption of gas when not running, while an electric station must keep going; ease of putting an abnormal number of cars, to run on the same line when there is an extra demand; ease of replacing the gas motors by electric motors if at any time thought advisable, while the inverse change cannot be made in an electric car.

The Dessau German Continental Gas Company in a recent report stated that the application of gas for driving street cars recently introduced in Dresden, may stand in importance next to the introduction of the Welsbach lamp, and that the absence of overhead or underground wires and big central stations makes it possible to work such a system with small capital, while the known cheapness of working of gas motors is by this means taken advantage of.

Gas Heating in German Hotels.

The *Gas World* notes that the German *Journal of Gas Lighting* published an article from *Hotelkeepers' Journal*, in which the relative advantages of heating by coal stoves, air, steam, water and gas for large hotel dining rooms and the like are discussed. The desiderata are stated to be: That the first cost and the current cost must be low; that the service must be simple, so that guests may not be disturbed; that the room may be quickly warmed up on short notice; easy regulation and prompt extinction when not wanted, as, for instance, when a ball follows a concert; and that even though the fire may have been out for several days there shall be no danger from frost. Ordinary stove heating is cheap in putting up, but the stoking disturbs the guests, unless it can be done from outside. Stoves take up too much room if sufficiently powerful; with iron stoves the heating is quick, but is not easy to regulate; overheating can scarcely be prevented, and fuel is wasted when the hall is only to be used for a short time; and so the current cost is not small under the usual conditions, where the hall is only used for from two to five hours at a time, there being seldom less, and usually more than 2 cwts. of coal employed on each occasion. Heating such apartments of large size from a central stove, either by water, air, or steam, for short periods at a time, does not work well; the cost of fittings is pretty heavy. These methods are best adapted for continuous heating, and this, if kept up, would be wasteful, while intermittent variations call for special skill and attention. Hot air is not easy to regulate, though steam and hot water act satisfactorily in this respect; ordinary water heating not so well; and shutting off the heat can be done with air or with steam pipes fitted with radiators, while ordinary water or steam pipes go on radiating for a good while after the water or steam is shut off, the result being very disagreeable when the room is already too warm. These central-stove methods require a long preliminary heating up; and this causes a considerable waste when the hall is used only for a short time; and also the fittings require adaptations in the mason work, except for hot air. In high winds air does not work uniformly, and in time of frost steam and water pipes are apt to freeze when not used, unless there is some heating, otherwise wasteful and useless, kept up to prevent this. The newer improved gas stoves have shown that in their use there is no carrying fuel and ashes about, that the fire can be lit at once on merely opening a stop cock, that the kindling is of the simplest possible kind—merely a match or an electric spark—that the full power can be put on at once, that the heat can be exactly and promptly regulated or instantly shut off without any loss of fuel, all these qualities being excellently adapted to the object in view; and that the heating apparatus can be readily connected with the gas supply, and in many instances readily shifted about the hall; that there is no dust; that no attention is required to keep the affair going, and the room is heated up in the shortest time, while with very simple arrangements for taking away the products of combustion there is no smell or smoke. At the same time, for such purposes as those in view, the current cost is often lower, and never higher, than that of other fuels. Gas heating is, therefore, according to the *Hotelkeepers' Journal*, preferable for such purposes to any other. The cost of apparatus is about $75 to $100 per 35,000 cubic feet of room space, and the hourly consumption of gas about 35 cubic feet in the severest winter cold. After this discussion the *Journal* goes on to give some instances of actual costs. At the Hotel Hirsh, in Limbach, there was a hall, with annexes, of altogether about 180,000 cubic feet space, in a very cold and exposed situation, open to the wind on three sides, with light roof, and two doors opening to the outer air. Stoves were used, but the hall was a cold one. Low pressure steam fittings would have cost $875; but the Limbach Gas Company offered to put in four Schaffer & Walcker's (of Berlin) patent double regenerative gas stoves for $450, and connections, etc., for $50. This was done. In December, when the hall was in use almost every evening, the consumption of gas was 38,100 cubic feet. In the extreme cold of 18th January, when the gas had not been lit for three days, it was lit at 6 P.M. for an entertainment at 8 P.M. The temperature outside was 5° F.; that inside was 23° F. At 8 P.M. these temperatures were 5° F. and 50° F., while 1,500 cubic feet of gas had been used. At 10 P.M. the temperatures were 5° F. and 60° F., while 1,236 cubic feet had been used during the two hours; and at 12 P.M. the external temperature was —2.2° F. and the internal 66.2° F., while 706 cubic feet of gas had been used during these last two hours. The total gas used was thus just over 3,500 cubic feet; and a hall in a less exposed position would have required less. This is considered "distinctly cheap and convenient." The flat cast iron apparatus stands up against the wall, and is considered to be an ornament to the room. In another place, the Casino Hall at Bochholt, 70,000 cubic feet capacity, four gas chimney apparatus by Schaffer & Walcker were put up; cost, $225; average results during January, 1893—external temperature, 5° F.; internal, 27° F. before lighting the gas; 66.2° F. in two hours; gas used, 565 cubic feet for the first two hours, and from 70 to 105 cubic feet per hour thereafter.

The Relation of Specific Gravity to Atomic Weight.

By A. N. Doershuk.

Since the study of chemistry by beginners and amateurs is so often hampered by apparently logical theories and conclusions which seem perfectly correct to the undeveloped eye, which has not been associated with the fundamental truths and underlying principles of this acute science, and, since views obtained from these theories and conclusions often cost much labor, time and many ungrounded misgivings, we ask your most worthy attention for a few moments while we explain one of these theories which so often worry the beginner in chemistry, and for which very few if any satisfactory explanations are given.

The problem generally presents itself in this shape:

"Why is the sp. gr. of iron (7.84), to the sp. gr. of aluminum (2.56) not proportionate to the atomic weight of iron (55.9) to the atomic weight of aluminum (27)?" Or, "Why is the sp. gr. of iron to the sp. gr. of aluminum not proportionate to the molecular weight of iron to the molecular weight of aluminum?" Or, "Why is it that the sp. gr. of a body, in a proportion to the sp. gr. of water, or (1), is not the same as the proportion formed by the molecular weight of that body and the molecular weight of water or (18)?" To get a clear idea of this matter, we must first know that the sp. gr. of a body is a "purely nominal value" and is "the relative weight of equal bulks of different bodies." From observation we know that a material difference exists in the "bulk or volume" of the same weights of different bodies, while the molecular weights of these bodies are nearly the same; therefore, density is as great a factor in determining the sp. gr. of a body, as is the intrinsic value of the element or elements contained in that body compared to a standard of weight. Physical research has taught that molecules are

never in absolute contact; in fact, the density of a substance is entirely dependent upon molecular affinity and the pressure and heat to which it is subjected. Let us take, for instance, a body the sp. gr. of which is .5, sp. volume 2, and its bulk twice as great as that of an equal weight of water. Now, if in the space between the molecules of this body we would place the same number of molecules of the same construction as are in the body, then its sp. gr. would be increased to 1, and its sp. volume reduced to 1; and if from the same body we would take one half of the molecules and leave the remaining half to fill the same space as was occupied by the original body, then its sp. gr. would be reduced to .25 and its sp. volume increased to 4. So we see that specific gravity is purely a mutable signification, entirely dependent upon the intrinsic value of matter compared to a standard of weight, and upon density which is regulated by molecular affinity, gravity, atmospheric pressure and heat.

It is clear that a proportion of the atomic weights of two different bodies could not be in a ratio with the sp. gravities of these bodies, be cause atoms of different elements unite in different numbers to form molecules, and the atomic weights of different elements are taken at different temperatures, while sp. gr. is always taken at the same temperature.

The impossibility of the molecular proportion is due to the fact that molecular weight is a constant quantity, being derived with all the ele ments from the same basis and under *similar* conditions, while specific gravity is a variable quantity, being derived with all the elements under *different* conditions, upon the same basis, and, as the same thing differ ently treated, does not yield the same result, so the specific gravity and molecular or atomic weight of the same substance, differently derived, cannot be expected to be proportionate in any way.

Fire Risks in Electric Insulation.

[By Mr. Frederic A. C. Perrine, in *Engineering Magazine.*]

In the early days of electric lighting—and not more than ten years ago at that—the writer was sent, together with other workmen, into the cellar of the laboratory connected with a prominent electric light ing company, with instructions to run the various circuits which were to be used in carrying current to the switchboards and instru ments placed in the room overhead. We were furnished with a beauti ful copper wire covered by a braiding of cotton yarns saturated with white paint and polished until it shone, a plentiful supply of staples, and such hammers as the stock room could afford. In stapling the wire to the floor beams overhead we were far enough advanced in elec trical knowledge not to drive staples through the cover to the copper in tentionally, and were well enough skilled in the use of the hammer to avoid striking the wire and knocking off the insulation in very many cases; though when lying on one's back and pounding in the dark with eyes filled by dust and dirt, it was not strange that a misdirected blow should occasionally fall.

Is there any wonder that when a year had passed and I was working as an electrician—having been promoted from cellar to laboratory—annoying fires would often occur and interfere with the experiments, bringing the necessity of pulling the switches and making the wires "dead" till the defective insulation of the circuits could be repaired? To be sure, these fires would occur most readily where holes in the floor allowed water from the morning mopping to trickle through to the beams below, but it is hardly possible that such construction would be attempted to-day even in the dryest garret.

Installations such as this, often followed by disastrous results, occasioned the fear of fires from the use of the electric current in the early days of electric lighting, and those early days, being so little removed from these present days, remain in men's minds, making them ask, "Can electricity be safely installed?"

Electricity, it must be borne in mind, is always and everywhere convertible into heat by passing it along a medium offering resistance to its progress, while the amount of heat developed is directly conditioned by the amount of current to be passed and the measure of the resistance to be overcome. The smallest current of electricity passing over the best conducting wire to be obtained raises the temperature, be that rise ever so negligible, but it is very far from being true that this amount of increase of temperature may not be perfectly controlled in circuits which are carrying their normal currents under no accidental circumstances.

The fires which may be occasioned by the introduction of electricity into our homes and workshops may be roughly divided into two general classes—those arising from an undue amount of current overheating the wires themselves, and those due to current escaping through defective insulation. Consequently the greatest care must be used in laying out a wiring system to avoid either of these causes for trouble.

To recur again to the early days, which even young men may remember, the defective construction above referred to was at fault only in the latter point; the copper wires were of ample area to carry any current likely to be sent over them, and the covering used was one as nearly fireproof as any ever devised, so that had even a considerable amount of overheating occurred there would have been little danger that the high temperature of the circuits would set fire to the building, but it was not realized that currents might escape from the wires and, running along the damp beams, set them on fire through the current which the wood itself was carrying. Indeed, the object lesson of a tree burning on a wet night, set on fire by some escaping current from an electric light wire, is even at the present time not altogether unknown.

Very early in the history of the art it was wisely recognized by the insurance companies that a properly installed system of electric lighting might be made at least as safe as gas or any other means of illumination, and in order to guard their interests strict rules have been laid down and inspection of all installations enforced by their agents. On account of this fact there have been a corps of men in their employ engaged in ascertaining all the possible causes for such fires and from their experience formulating the requirements of perfectly safe installations.

In laying out his circuits the electrician's first concern is for the loss of energy occasioned by forcing the current over a wire, and at the same time he endeavors to have the outlay for copper and insulation as small as possible. With any definite percentage of loss it may be possible that the wire employed will be of such a size as to produce dangerous heating, and to guard against such an effect the rough rule was at first laid down that the density of the current should not be more than 1,000 amperes per square inch of cross section of the wire. This rough rule took into account only the heat generated, and did not allow for the fact that, while the heat was generated throughout the entire mass of the wire, it was radiated only from the surface, which in any round wire varies as the diameter, while the cross section or mass varies as the square of the same dimension.

For comparatively small wires this rule is sufficiently accurate, but through the experimental investigations of Kennely and Forbes there have been deduced formulæ by the means of which wires used under all conditions may be accurately proportioned for any definite increase of temperature, and at present the wiring rules state either the amount of current which each size of wire may safely carry under certain conditions or that the rise in a circuit shall not be beyond a certain amount above the temperature of the surrounding air.

In such perfectly proportioned circuits local increases of temperature to a dangerous amount may be occasioned by the extra resistance of a defective joint between two pieces of wire, and such a contingency can only be guarded against by careful workmanship in soldering all joints which have at first been well secured by twisting or by means of suitable sleeves and couplings.

In spite of the best designed and best constructed system of wiring, accidental crosses may be occasioned by decay in the insulation or by me chanical occurrences which bring the two wires of the circuit into contact, cutting out the lamps or motors beyond the point in question and throwing the whole power of the machine into a much diminished resistance; a great rush of current follows, and high heating is produced. Similar effects may be produced by crosses with the wires from another system in which the pressure is greater than that for which the wiring has been calculated.

Now, to guard against the evil effect of any such great accidental increase of current, it is found advisable to sacrifice some one portion of the circuit in question and avoid the overheating of wires in the neighborhood of inflammable materials. For this purpose, at all the branches in any circuit, as well as at the point where the main wires enter the building or leave the dynamo, small porcelain boxes are placed containing terminal contacts for the wires and making a break in the circuits which enter and leave them; in this gap between the contacts safety fuses are introduced into the circuit. These safety fuses are short pieces of wire made from some fusible alloy capable of melting at a temperature too low to set fire to any inflammable material on which it may fall while melted. Each fuse for any circuit is so proportioned that a definite amount of current will melt it, and in this manner a dangerous increase of current will automatically break the circuit and stop its flow.

Indeed, these little safety fuses are the most important element for protection against fire in any electric installation, and the greatest care must be used in their location and proper maintenance. Provided the

wireman in his haste has not substituted for them bits of copper or handy nails, the installation which is properly "fused" may be considered safe.

Any cause whatever of an increase of current above the normal will cause these ever watchful little safeguards surrender their lives to the make of the remainder of the circuit. To be sure they are but mortal and have their almost human failings, and they may persistently b"rn out if placed in an overheated room; they may not be quick enough to prevent some "sneak" current which follows a minute break in the insulation from setting fire to a board along which it finds its way to a neighboring gas pipe, but in the main they are true monitors and their warning should be heeded.

The "leaks," "crosses" and "sneak currents" spoken of above are all fertile causes of electrical fires, and are occasioned by defects in the insulation of the wires which result in currents passing over res stances so great as to cause undue heating. E ther by the "crosses" sending too great currents over wires properly proportioned for their normal work, or by the "leaks" sending currents of electricity over semi-conductives, such as damp woodwork, while the "sneak currents" are minute leaks which do not send a sufficiently great amount of current astray to increase the amount in the circuit sufficiently for blowing out safety fuses.

While the safety fuses are the reliance when these accidents occur, yet in the normal and possible circuit the fuses are never called upon to perform their office. Insulation is the means of prevention of all these dangers; insulation is the great need in a safe installation; to the insulation we must look in installing our plant, and to the maintenance of the insulation we should devote our energies after the circuit is in operation.

As modern plumbing, gasfitting and steam piping have revolted against concealed work, so the first method which has been successfully adopted for safely running wires in buildings and the method which is always used in factories is to run the wires in plain sight, and when porcelain or other non-absorbent insulators are used in supporting the wires to keep them away from contact with the surrounding woodwork or walls, a very high degree of safety is obtained. There is the single ob jection to this method of construction in the power the electrified wires have of attracting and retaining floating particles of dust or lint, such as are often continually flying in the air of a manufacturing establishment. I have seen wires in such a place, which originally were hardly more than a quarter of an inch in diameter, attract cotton lint till they were more than an inch across, having the appearance of some hairy caterpillar creeping along the beams of the floor above, and I have known such dust-laden wires to carry a small fire in all directions, till, before the original blaze could be extinguished, a half dozen other fires had been kindled and the building was doomed to destruction. Of course, such an effect is only indirectly due to the electric installation, but, had the danger been appreciated and the wires kept free from such attracted particles, the small amount of labor necessary for the task would have saved thousands of dollars.

In an office building or a house, however, these unmasked wires interfere too much with the surrounding decorations or wall finishings, for, wherever the circuit is run, lights are needed in many places in the room, and the network necessary on the ceiling is apt to be very unsightly, especially as it seems impossible to run and keep the wires straight in all changes of temperature unless they are supported through their entire length, so that the expense of endeavoring to produce a decorative piece of work in such a manner amounts to as much as that necessary to do concealed work safely.

For concealed construction the first method used was to incase in a lead pipe the wire which had been previously carefully insulated with rubber on a saturated fiber. Such a lead covered cable was then buried in the plaster of the walls or placed behind the lathing with the ends brought out to the various switches and lights. Though thus to cover the wire with a double waterproof protection of an insulating material and an impervious lead pipe may seem at the first sight an ideal method of installation and one likely to be enduring in its properties, yet I have seen short circuits cause the plaster to fly in all directions from the walls of one of the handsomest public buildings in the country when the current was first turned on the circuit; and though the electric plant had cost thousands of dollars, it was soon almost beyond repair, and in the place of these buried lead cables it became necessary to use a most unhandsome external circuit in preference to tearing out and replacing the defective wires; which alternative would have necessitated replastering a large portion of the building. And yet this trouble was not due to any defect in the method or the original properties of the lead cables, but to the impossibility of obtaining perfect workmanship and absolute care on the part of all the men—carpenters, lathers, plasterers and electricians—who had been engaged upon the immense building.

At the present time the likelihood of defective workmanship and mistakes is recognized much more fully, and it is not attempted to build an inflexible system into the walls of any building, but methods have been devised by which it is possible to withdraw defective wires and replace them without injury to the walls or woodwork of the building. Of course something must be fixed in the installation, but it is preferred at the present time to fix the conduit conveying the wires rather than the wires themselves or their insulation.

In old buildings where gas has already been installed and it is not deemed advisable to tear out the walls for a system of conduits, there has been devised a neat molding having two grooves into which the wires may be laid, where they are then covered by a cap running lengthwise of the molding, and which, when completed, may be painted or made to harmonize in any other manner with the neighboring decorations.

While this molding system of conduits is extensively employed in old buildings and along wooden walls such as are found in our magnificent river and Sound steamers, it is generally regarded with less favor than a system of round tubes made of some insulating material which are run under the plaster and terminate in junction boxes from which the wires may be pulled through the tubes. This is perhaps the safest and most satisfactory system of wiring any building, and this method combines the least possible interference with the decorations, together with the greatest immunity from fear of fire. The tubes here spoken of are in some cases of paper strips wrapped spirally around a mandrel, the tube so constructed being plunged into melted asphalt which is maintained at a high temperature; some are made of a low grade rubber, and others of a combination of a paper tube with a rubber sheath, and the whole finally finished by a braided covering. The two latter tubes, being flexible, do not require any elbow pieces at the bends and present a smoother internal surface for drawing in the wires, but they possess the disadvantage that, on account of their flexibility, they are not so capable of resisting accidental blows or misdirected nails while the plant is being installed.

When such a complete system of tubing has been installed in a house and connected to the junction boxes, there is provided a continuous insulating and waterproof conduit passage for the wires from their original entrance into the house for the last light. The fuses, which must be as carefully attended to on this system as on any other, prevent any great rise in the temperature of the wires due to any external causes; while the tubes themselves offer no path for the leak through a defective insulation, and, in consequence, any system so installed may be considered to be perfectly safe against danger from a fire caused by the electric installation.

As we have said already, the fact that electricity is always convertible into heat by passing a current over a resistance, taken into account with the defective character of the early installations, has served to turn men's minds to electrical fire risks and made them inquire into the means of prevention of such fires; it is therefore useful to examine the statistics of our fire insurance companies and note what proportion of fires are of electrical origin.

From 1884 to 1889 the Massachusetts Insurance Commissioners' report shows that out of a total of 12,935 conflagrations in the State there have been 42 traced to electric wires—scarcely half of 1 per cent. While it is yet more striking to notice that in 1887 there were 14 fires of an electrical origin, and in 1889 there were but 7 such fires in approximately the same total—but one more than in 1884—and this too in the face of most enormous extensions in electrical installations.

In this connection it is interesting to note the other causes which are comparable to electricity in producing fires, and one is astonished by their triviality.

Kerosene oil (breakage and explosion)	947
Careless use of matches	437
Curtains or goods exposed to gas or candle	224
Thawing water pipes	89
Clothes drying near stove	64
Fat boiling over	43
Cigar stub in wooden spittoon	41
Smoking in bed	34

And it is further noticeable that the most important of these causes are accompaniments of other methods of illumination.

To be sure, it is true that even the most trivial cause may be the origin of the largest fire, as in the oft repeated story of the great Chicago fire, which was started in a stable by an overturned lantern, and as was re-

cently the case when in Lynn, Mass., "a draft from an open door blowing the blaze of an oil stove down around the burner, causing the stove to explode," originated the great fire which consumed so many of the shoe factories of that city in 1889.

In his report for that year the Insurance Commissioner, after commenting on that Lynn fire, says: "In the case of Boston the preponderance of testimony seems in favor of the theory that it was caused by the electric wires; and, if this be the true theory, then it follows that two fires, which together destroyed over eight million dollars, could easily have been avoided."

Indicating, therefore, that in the judgment of this high insurance authority, Mr. George S. Merrill, a fire from an electric installation is practically always preventable if the work is properly done and the installation regularly tested. We believe that we may truly say therefore that an installation for the electric lighting of any building may be made perfectly safe as regards fire risks; using the word "perfectly" in the human sense, for we know nothing connected with either science or our daily lives in which every form of possible accident may be absolutely guarded against.

Such a perfect installation we now understand to be one in which the wires have been properly proportioned to carry their normal current without undue heating; where also fuses are placed on all the branches to blow out whenever the current rises dangerously above that normal. and where not only the insulation of the wire is thoroughly waterproof, but where also its supports are of an incombustible waterproof character and so arranged as to keep the wire out of contact with all combustible materials; and, above all, where by proper inspection, cleaning, and testing, the installation is maintained in its original character throughout its entire life.

To be safe, then, good and honest workmanship must be maintained by constant watchfulness and not by fancied security.

Methods of Governing Gas Engines.

Mr. Albert Spies, in the course of a series of articles in *Cassier's Magazine*, on modern gas and oil engines, referring to the matter named in the heading, remarks that not less important than the methods of igniting are those of governing, and considerable ingenuity has been expended for years past in developing various contrivances designed to satisfactorily solve the gas engine governor gear problem. At first thought, some sort of throttling gear by which the gas or oil vapor supply to the cylinder is gradually reduced as the speed increases, and vice versa, is apt to suggest itself as a desirable one, and, as a matter of fact, many gears of this kind have been made and are used, both Lenoir and Hugon having followed this method of governing in their early engines. Its wastefulness, however, becomes apparent on even slight consideration, so that one may well wonder that at this late day the throttling governor is still countenanced in gas engine practice. It is obvious that if, with such a governor, the volume of gas or oil vapor admitted to an engine cylinder is diminished, the volume of air admitted is correspondingly increased, and it is well known, too, that the limits of variation permissible in explosive mixtures of gas and air are comparatively narrow, so that if, in a total volume of mixture, the volume of gas either exceeds or falls short of a certain, elastic proportion, no explosion can be produced. While, therefore, a gas throttling governor may either increase or diminish the force of the explosions in the engine cylinder by varying the strength of the gas and air mixture between these limits, yet if one of the limits be passed, and the gas volume, for instance be too greatly diminished, ignition of the mixture will be missed and whatever gas has been taken into the cylinder will then be discharged into the exhaust pipe unburnt and without having given up any of its energy. Under these circumstances the engine will work exactly as though no gas whatever had been admitted, and the speed will cease to increase, gas being simply pumped through the cylinder and wasted until its proportion is again increased, by the subsequent opening of the gas valve to that point where the mixture once more becomes explosive.

No better evidence is needed of the fact that the wastefulness of the throttling governor method has met with a fair share of recognition, then the extended application which for years has been given to what have been termed "hit-and-miss" governors. With these the strength of the explosive gas and air mixture is never changed, but the number of explosions in the engine cylinder in a given time is varied to suit the prevailing requirements, being increased when the speed falls below, and decreased when it rises above a certain normal; or putting it in a slightly different way, when the speed falls off, the governing device hits the stem of the gas supply valve, causing the latter to open and admit gas into the cylinder, while when the speed becomes too high, the governor, by changing its position, misses the gas valve stem, the valve consequently remains closed and no working charge reaches the cylinder.

One objection to this method of governing always has been that it gives the engine a jerky, unsteady motion which is fatal to success in electric light work, and in order to overcome this, some engine builders now provide the governor cam which strikes against the gas valve spindle with several steps, so that instead of being either full on or full off, the gas valve may be opened through intermediate degrees. The strength of the explosive mixture may thus be varied to some extent, but whenever the lower limit of gas percentage necessary to constitute an explosive charge is reached, the gas valve is closed entirely, and the engine then runs without explosions until the speed again drops. The stepped-cam governor, in fact, combines a throttling with a cut-off action.

The ideal method of governing, however, would seem to be one akin to that followed in modern, high-class steam engine practice—one by which the strength of the working charge would be kept always the same and only the quantity for each working stroke would be varied. In all processes of combustion there is a certain percentage of oxygen, which, by combining with a certain percentage of combustible, produces a maximum effect, and any variation from these relative proportions will represent a loss of efficiency. This is fully as true of the combustion of gas in a gas engine cylinder as of the combustion of any other kind of fuel in any other place, and the economic bearing of maintaining a constant and certain strength of explosive mixture in gas engine work will, therefore, be at once recognized.

Smokeless Combustion.

Some trials at Berlin for securing complete combustion with the absence of smoke have, it is stated, induced the North German Lloyd and the Hamburg American Packet Company to adopt the system, which is thus described: Coal reduced to powder—not necessarily very fine, however—in centrifugal disintegrators, is introduced into a pear-shaped combustion chamber lined with firebrick, and fitted with an induction apparatus like those used in petroleum-fired furnaces, the coal dust being drawn along by a jet of steam or compressed air. The combustion chamber, which takes the place of a furnace, is provided with two apertures, one in the center line of the boiler—in case of such an application, for instance—occupying the position of the usual fire hole door, while the other, on the opposite side of the combustion chamber, serves for introducing the coal dust through a pipe, so placed that the dust is evenly dispersed over the whole extent of the chamber. After the first ignition of the dust, which may be effected by any source of heat, the combustion is said to continue very intensely and regularly under the action of the air current, which is regulated in accordance with the quantity of dust necessary to produce the degree of heat for the required amount of steam. The air or steam and coal dust are intimately mingled in the zone of combustion, while the speed of the current, which has served as a vehicle for the dust, is very much reduced. Each particle of fuel held in suspension is, by this method, brought into such intimate contact with the oxygen necessary for its combustion, that this combustion is so complete as to allow scarcely any smoke to be perceptible. The air introduced into the combustion chamber may also be previously heated by the waste gases, so as to constitute a regenerative system capable of affording an intense heat for metallurgical purposes.

High Steam Pressure.

It is accepted as settled according to good authority that engines can be worked with a less consumption of steam if run at a high boiler pressure, on either the compound or other multiple-expansion systems, than at low pressure, and the present tendency in steam engineering circles is toward an increase of pressure rather than a decrease. What the exact ratio of gain is as the pressure is increased has not been absolutely determined by any experiments of which we have record, says the *Engineering Record*, but there are sufficient data which may be obtained here and there to make the fact of the increased saving certain. For example there are experiments on record showing that a compound engine of the Corliss type, working under 80 pounds pressure, will use from 16 to 17 pounds of steam per horse power per hour. There are other cases where a similar engine at 110 pounds pressure uses from 13 to 15 pounds of steam per horse power per hour. Other data are available which show that at 150 pounds pressure the consumption of steam is reduced by triple-expansion engines to 13 pounds, or, perhaps, as low as 12.5 pounds. Making allowances for differences in the type and

condition of different engines from which data have been obtained, there is ground for the belief that with an increase of pressure from, say, 100 pounds to 150 pounds in the compound engine, with suitable change of proportion to realize the full advantage due to expansion of the steam, there is at least 10 per cent., and perhaps 15 per cent., saving in the engine carrying the higher pressure. Without going into refinements, there is further reason to believe that between a compound engine running at 100 pounds, and a triple expansion engine running at 150 pounds, both suitably proportioned and loaded, there is a similar gain of at least 10 per cent., and perhaps 15 per cent., due to the engine working under the higher pressure and greater expansion.

These figures are given to show the general feeling among those who are well informed, rather than to define exactly the relative economies; and it may further be added that they are intended to indicate the relation which exists in engines which are in good order and well maintained, and the relative economy only in the consumption of steam.

To secure the benefits of high pressure it is necessary to provide extra strength in the boilers, in the steam piping and in the engine itself, or at least in the high pressure cylinder, to withstand the increased strains. It is necessary to employ more stable joints, besides a better class of packing, and the whole equipment must be adapted, in its various details, to resist the stronger forces which are brought to bear upon it. When the plant has been well designed for these special duties it must, when set to work, be watched with increased care, and by a more skillful class of attendants, to keep it properly maintained, than one designed for low pressures. The breaking out of packings, and the increased wear of steam valves and pistons in the engine, introduce waste where high pressures are carried, which may be entirely absent where the pressures are limited to those which have been common in the past. Extra wear and tear and depreciation and the losses of steam and fuel which they cause, are the accompaniment of excessive pressures even when the construction is of the best class, and these, so far as they act, offset the intrinsic advantage which might otherwise be obtained. The interest and depreciation charges on the more complicated and expensive plant, the waste of steam referred to, the extra cost of attendance, and the increased cost of repairs and supplies, use up at best a large part of the saving of fuel, which can be made by the more economical engine, and these may become, with careless management, even larger in quantity than the entire amount of saving so that the use of high pressure produces a net loss rather than a gain.

Unless those who are intending to profit by employing excessive steam pressures and a properly proportioned engine, either of the compound or triple expansion class, are prepared to combat the difficulties in handling increased forces here briefly referred to, and make proper allowance for the waste of fuel and expenditures incident thereto, it is almost folly to expect in the end satisfactory results.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

A CORRESPONDENT at Lima, O., forwards the following, under date of October 6th: "The Lima Natural Gas Company has evidently determined to supply its patrons with an ample volume of gas for fuel this winter, for in the past few months the Company has drilled 14 new wells in the St. Mary's field, some of which are reported to be good producers. The Company is completing a new pumping station, in which has been installed a set of pumps, with new boilers, an equipment that doubles the pumping capacity at command last winter. The Company is also building a plant of the Askins type, rated to a daily production of 1,000,000 cubic feet, the output to be distributed in the mains conveying the natural article. The Stacey Manufacturing Company is constructing a holder, the same to be used as a governor to manage the gas produced by the Askins plant, and it is thought the new equipment will all be in working order by November 10th."

MR. G. L. COLE has purchased a controlling interest in the property and possessions of the Beloit (Wis.) Electric Light Company.

THE project for the establishment of a Gas Company at Westwood, N. J., seems to be hanging fire, although the promoters assert that they are in earnest about the matter.

THE Metropolitan Company has notified its customers in the Bay Ridge (L. I.) district to return their receipts for meter deposits, when the latter will be returned to them with interest.

A CORRESPONDENT at Troy, N. Y., writing to the JOURNAL, under date of October 7th, says:

To the Editor AMERICAN GAS LIGHT JOURNAL: Some days ago the local paper at Whitehall, N. Y., published an account of the legal decisions in several actions brought by the Gas Company of that place against the village authorities to recover what plaintiff thought was its just right in the matters therein set forth; but as the paper does not give a very clear or comprehensive statement of all the actual facts, I thought perhaps a little history of the case might not be uninteresting, as setting forth what small gas companies have sometimes to contend with. After having supplied the citizens of Whitehall for the past 30 years with gas and lighting the streets of the village, with some 50 to 60 gas lamps, for the munificent sum of $1,800 per annum, which included the light for its public buildings, the Whitehall Gas Light Company concluded to ask for and was granted a franchise to erect poles and string wires, etc., for the purpose of supplying electric light to such of its inhabitants who desired it. The franchise or grant was as follows: "At a meeting of the Board of Trustees, held April 3d, 1890, the following resolution was adopted: *Resolved*, That the Whitehall Gas Light Company be granted the right to erect poles in the village of Whitehall, N. Y., for the purpose of stringing electric wires for lighting private or commercial buildings; and the poles shall be of sightly appearance, and set not to interfere with private or public property, and under the supervision of the Board of Trustees, the said Whitehall Gas Light Company to indemnify the village against all loss or damage that may occur therefrom.—CHARLES J. BARKER, Village Clerk." However, in less time than the required poles could be erected, the authorities reconsidered their action and rescinded the franchise, and later on granted an exclusive right and contract to light the village streets to one of its citizens, with the result that after setting three or four poles, and stringing a few feet of wire, he failed to go further with the undertaking, but for some time thereafter carried both contract and franchise in his pocket looking for a purchaser but found no taker. The Gas Company having established a plant, by stringing wires on the houses, with consent of owners, was supplying such of its customers with electric light as desired, and it was then that the Trustees ordered all poles and wires removed from the streets, as per resolution (the newspaper account to the contrary notwithstanding) which is appended: "Whitehall, N. Y., Oct. 31, 1890. J. H. O'Callahan, Supt. Whitehall Gas Company: At a meeting of the Board of Trustees, held Wednesday evening, October 29, it was *Resolved*, That all poles placed in this village for the purpose of stringing wires for electrical purposes, and all wires strung through or over the streets of said village for electrical lighting be forthwith removed, and in case the same are not removed within 24 hours after such notice, that the Street Commissioner remove the same at once, at the expense of the party placing the same in or over said streets. By order of the Board of Trustees, S. A. CONEY, Village Clerk." At this time another electric light company appeared on the scene, and the authorities hastened to furnish them with another franchise and contract to light the streets, etc., but with little better success than the former one; for after establishing a cheap plant and stringing a lot of iron wire, they managed to supply a few lamps, but in less than a year's time they collapsed and were sold out by the sheriff, the Gas Company purchasing the pole line. After this experience the village concluded it would at least take a rest respecting electric lighting, and the Gas Company was called on to once more start up its business; and so, for a time, the town once more slumbered in the serene rays of the street gas lamps. This was not of long duration, however, for it was soon awakened from its lethargy to again struggle with the electric problem, and when bids were advertised for (a new departure, by the way) to do the public lighting, the Gas Company concluded it was at last "going to be in it;" in fact when it was discovered later on that its bid was the only proposal submitted, the Company concluded it at last had a "sure thing;" but, alas for all human calculations, just as it imagined the plum was within its reach it fell into the other fellow's basket. At the last moment another citizen candidate for electric honors appeared, and the Gas Company again had the humiliation of seeing another franchise and contract carried off, and at a higher bid than it had proposed to do the same service for—the Gas Company asked $3,200 for the service, the "citizen candidate" asked $3,700. Through the protest of several taxpayers, action was brought to nullify these proceedings, with what result the decision by the Court will explain. The above constitutes about the whole transaction, from the first proposal to introduce electric lighting in the village of Whitehall to the present day, when the people are having the advantage (?) of two electric lighting plants and a gas works to make them happy; and if the Gas Company does not enjoy the luxury of a monopoly, it at least has had an experience that has proved exciting.—TROY.

THE following is a summary of the decisions of Judge Kellogg in the instance of the action brought before him to determine whether the Trustees of Whitehall had acted within the law in the matters above referred to by our correspondent. There were three of these actions. The first was brought to restrain the Trustees from granting an exclusive franchise for lighting the streets by electricity. Judge Kellogg sustains the contention of the plaintiff that the Board of Trustees had no right to grant an exclusive franchise, but at the same time held that there was no sufficient proof of any intention on the part of the Board of Trustees to grant an exclusive franchise, and that if such exclusive franchise were granted it would have done no harm, since it would have been absolutely void. The second action was brought by the Whitehall Gas Light Company against the Board of Trustees to restrain them from interfering with the poles and wires belonging to the Gas Company on the streets. Before the trial of this action proceeded the plaintiff offered to discontinue it, inasmuch as there had been no interference on the part of the Trustees with said poles and wires. The defendants, however, would not consent to a discontinuance, and the action was tried. Upon the trial Mr. Davis (of counsel for the village) testified that "nobody to his knowledge on the Board of Trustees had made any objection or given any intimation that the poles should be removed or interfered with in any shape or manner," and it appearing from the evidence that there was no intention on the part of the Board of Trustees to interfere with the Gas Company's poles and wires, the Court decided the action in favor of the defendants, but without costs. The third action was brought in the names of several taxpayers to restrain the Board of Trustees from carrying out the contract for lighting streets with a bidder named McLaughlin (the "citizen candidate" referred to by "Troy,") at the rate of $3,700 per annum, upon the ground that the action of the meeting awarding such contract was illegal and void. In regard to this Judge Kellogg held "that the meeting and vote must be regarded as a nullity, and that all subsequent acts of the Trustees in making the contract with McLaughlin were illegal." The Judge, however, in stating his reasons in detail for his decision, does not hold that the vote by which the contract was awarded was void because of a wasteful disposition of the village funds, but that the disqualification was in the fact that the polling places were only kept open from the hours of 2 to 4 P. M., instead of the period prescribed by the laws of 1888, chapter 172, which declare that in such cases the voting shall commence "at 1 o'clock in the afternoon, or at such earlier hour in the day, after sunrise, as the Board of Trustees may direct, and *shall* continue until sunset."

THE new business headquarters of the Oakland (Cal.) Gas, Light and Heat Company have been removed to the elegant and commodious building recently completed by it, on the northeast corner of 13th and Clay streets, that city. The housewarming was a very pretty one, and Secretary Britton presides with dignity over the establishment.

THE works of the new Gas Company for Montreal are to be located in the Cote St. Paul district, and the syndicate that is constructing the buildings announce that they will be ready to receive the machinery by December 1st.

SOME days ago Mr. James McDonald, Chairman of the Massachusetts State Board of Gas and Electric Light Commissioners, tendered his resignation to Governor Russell as a member of that body. Mr. McDonald, who has served on the Board for about a year, states that he resigns because of his wish to devote himself to the practice of his profession as a lawyer. He performed the duties of his office acceptably, and, reading between the lines, the only inference one at this distance can draw is that the Commissioners are overworked and underpaid.

AT a special meeting of the Directors of the Ottawa (Canada) Gas Company, Mr. Thomas Dunderdale, of Montreal, was appointed General Manager, replacing Mr. Humphries. Mr. George Spittal was elected Secretary and Treasurer, and Mr. John Holt was reappointed Superintendent.

"OBSERVER" writes that the adjourned meeting of the Woonsocket (R. I.) Gas Company was brought off on the appointed day, when the following officers were chosen: Directors, Messrs. Henry C. Kimball, John W. Ellis, Henry F. Lippit, George M. Welles, Joseph E. Cole, Jas. P. Ray, Frank Harris, Gilbert Darling, Joseph B. Aldrich; President, Joseph E. Cole; Secretary and Treasurer, R. G. Randall. The report of the Treasurer showed a good surplus after paying dividends and also showed the business of the Company to be increasing from year to year. The regular semi-annual dividend at the rate of 6 per cent. per annum is now payable.

MR. BURLINGAME, a well known prospector on the Pacific Coast, has made a valuable discovery in locating a bed of excellent bituminous coal, close to Mojave, or at a point about 130 miles from Los Angeles, some 13 miles back of the Southern Pacific Railroad.

MR. GEORGE B. ALTER has brought suit against the Equitable Gas Company (natural) of Pittsburgh for damages in the sum of $5,000, which he claims property of his in Plum township has sustained through the main laying operations of defendant.

THE following letter, which explains itself, is from Mr. George D. Copeland, and refers to the proposed establishment in San Diego, Cal., of an electric lighting plant to be operated by the municipality: "The statements recently published by authority of President Barker, of the municipal Board of Delegates, and Dr. Powers, of the San Diego Gas and Electric Light Company, are of much interest to the people of San Diego, and should receive careful consideration. The city is liable to make a big mistake if the figures given by President Barker are relied upon, as Doctor Powers very forcibly points out; but the latter seems to acquiesce in the rate of 25 cents per month for the use of each incandescent lamp which is to be supplied to private consumers or used by the city. Now, such a rate is so ridiculously low that anyone at all conversant with incandescent electric lighting will at once see that neither of the above-named gentlemen seems to be at all posted as to the cost of producing incandescent lights. In December, 1888, I commenced to furnish incandescent lights to the business men of this city. At that time Dr. Powers, who was then, as now, President of the Gas and Electric Light Company, gave me warning that his Company would compete with me in the incandescent lighting business, and in accordance with his policy, which was to run the Westinghouse plant out of the business, he put in a dynamo of the Slattery type and started in at incandescent lighting a little before I did. He charged a uniform rate of $1.50 per month per lamp, and after one year of trial gave up the fight, and the books of the Company will show a loss at the said rate. The fact is that the actual cost of the power to produce a 16 candle power incandescent light with the Westinghouse system, which is admitted to be the most economical system for long distance lighting, is more than double the amount (25 cents) proposed to be charged by President Barker. Then, again, Mr. Barker does not seem to understand that incandescent lighting for long distances, such as are involved in the distribution of lights in San Diego, cannot be successfully carried on with the same dynamos with which arc lights are produced. Only alternating current dynamos will answer the purpose and these cannot be successfully used for arc lights. The fact is that the distances to be traversed in this city by the wires of any incandescent system which would undertake the general public or private lighting in competition with kerosene oil at 15 cents per gallon put it out of the question for any company, and much less the city, to furnish lights at less than four times the price named by President Barker. It is easy to figure out profits beforehand by those interested in putting in new plants. I am myself a victim of the 'future profits' calculations, not only in the electric lighting line but in the building of water works. The city authorities should go slow and thoroughly investigate before relying upon such wild and misleading figures as those presented by President Barker."

THERE can be no doubt about it that Mr. Copeland's comment on the estimate of President Barker to supply 16 candle power lamps on a self-sustaining basis, at the rate of 25 cents each per month, is just and truthful. To prove that the rate is absurdly low one has only to remark that a fair article of steam coal is worth $5.50 per ton in San Diego.

NEWS from Elmira, N. Y., is to the effect that, on the day set for a preliminary hearing in the matter of proceedings instituted for the dissolution of the Elmira Gas and Illuminating Company, the noteworthy feature was the presence of a score of attorneys, the majority of whom evidently represented interests which were opposed to the dissolution scheme. After some desultory verbal skirmishing, the Hon. M. Rumsey Miller, before whom the proceedings are to be conducted, declared the sitting adjourned until November 3. The present state of the Elmira Company is in queer contrast to the position occupied by it when under the domination of the Messrs. Arnott.

DO not forget that the exhibit of Messrs. James R. Floyd & Sons, at the World's Fair, is located in Machinery Hall, Section 26, Column O–27. Among the things shown are the Ogden quick-acting valve, valve stand and indicator, and mouthpiece with self-sealing lid, and the exhibit is well arranged and displayed.

THE firm of Messrs. Read, Holliday & Sons, Limited, of Huddersfield and Wakefield, England; Rouen, France; and Brooklyn, Philadelphia and Boston, in this country, report the following results obtained in working their hydrated oxide of iron for gas purification on a large scale:

After	1st	removal	from	purifier	the	mass	contained	17 p. ct. free sulphur.
"	2d	"	"	"	"	26.4	"	"
"	3d	"	"	"	"	2.0	"	"
"	4th	"	"	"	"	31.0	"	"
"	5th	"	"	"	"	35.2	"	"
"	6th	"	"	"	"	(?)	"	"
"	7th	"	"	"	"	39.1	"	"
"	8th	"	"	"	"	42.63	"	"
"	9th	"	"	"	"	(?)	"	"
"	10th	"	"	"	"	50 17	"	"
"	11th	"	"	"	"	(?)	"	"
"	12th	"	"	"	"	52.31	"	"

And as the material is still in active work and shows no sign of becoming spent, it may reasonably be assumed that a higher percentage of sulphur content will be reached before new oxide is substituted for it.

SOME time this month the arbitrators to fix the price of gas in Louisville, Ky., to private consumers and for public lighting will meet to establish the rate for the next five years. This regulation is made necessary every five years under the stipulations of the Company's charter, which provides that a commission shall be appointed every five years to adjust or revise the gas charges for the five years following their decision. It is specified that the city shall select one expert, who shall be a civil engineer, and the Gas Company another, who shall also be a civil engineer, and if these two fail to agree the Chancery Court shall select two others. The maximum price of gas per 1,000 feet shall not be above $1.35, nor shall the price be higher than to allow the Company to declare an 8 per cent. per annum dividend on its stock. Mr. J. G. Johnson has been named by the city as its representative, and a Mr. Montford will represent the Company. The Company now charges $1.35, with 5 per cent. off for prompt payment. It is not likely that any decrease will be ordered in the rate, although there is a bare possibility that the discount will be increased to 10 per cent.

THE Indiana Light and Power (electric) Company, of Goshen, Ind., has gone into the hands of a receiver.

THE Gas Committee of the City Council of Fredericksburg, Va., after "a mighty struggle of thought" in respect of what should be done to better the storage capacity of the gas works, has finally decided to put a new crown in the old holder, which it was feared would go to pieces on more than one occasion last winter. This is simply throwing money away, for what the old structure really needs is a new crown, new circumference, new guides and a new tank—that's all.

THE New England Gas Control Company has been organized by Messrs. John P. Leahy (President) and Jas. F. Reynolds (Treasurer), both of Boston, the incorporation having been effected at Biddeford, Me. The objects of the Company are "to make and sell gas governors and other appliances for regulating the consumption of gas."

THE naphtha tanks of the Holly Springs (Miss.) Gas Light Company were destroyed by fire early this month, but the manufacturing plant was not injured.

A CORRESPONDENT at Bath, Me., writes: "The contention between the Bath (Me.) Gas and Electric Company over the public lighting contract is as pronounced as ever. The Hon. Mr. Twitchell, the Treasurer of the Company, who is outspoken regarding the position assumed by the Company, asserts that if the contract is not made by November 1st, in accordance with the terms originally proposed by the Company, the lights will be shut off by the 1st prox."

THE proprietors of the Fresno (Cal.) Gas and Electric Light Company have been asked by the city authorities to name a price for their property, with a view to its purchase and operation on municipal account.

IN our last issue brief mention was made of the death, at St. Louis, Mo., on the 2d inst., of the Hon. Erastus Wells, ex President of the Laclede Gas Company, of that city, and it is to the courtesy of Mr. Frederic Egner that we are enabled to place before our readers the following history of deceased: "Death has at last claimed Erastus Wells, who for nearly three years had been a sufferer from locomotor ataxia. From 1843, until he retired in 1879, and for the years after, until ill-health enforced his entire seclusion from active life, no man was better known or more generally loved and respected in St. Louis than Erastus Wells. He was a native of Jefferson county, New York, received a limited common school education, and, at the age of 19, came to St. Louis. He was a self-made man in every sense of the term, and on his arrival in St. Louis (1843) his capital, the savings of his pittance while clerking in Lockport and Watertown, N. Y., amounting to $140. He became acquainted with Galvin Case, and together they built an omnibus, the first vehicle of the kind seen west of the Mississippi river. It was a rude affair, without glass windows, and cost $200, but it was the foundation of the great street car system of the St. Louis of to-day. It ran daily over a route from Third and Market streets, along Third to Broadway to North Market street, and the receipts for the first six months averaged $1.50 per day. In 1844 business had increased to an extent that warranted the putting on of another 'bus; five years later 15 'buses were in service. For two years Mr. Wells drove one of the 'buses himself. When the business became a money maker, Mr. Wells sold out at a good price and established a lead factory, but nearly lost his life by lead poisoning and was obliged to retire from active business for a year. In the latter part of 1850, with his old partner, Case, he established an omnibus line from St. Louis to Belleville, and a few months later Wells' stages ran out Olive street as far as 17th street, the limits of the city's growth. In 1859 street cars were introduced in St. Louis, succeeding the stages. The St. Louis, Missouri, Citizens' and Peoples' street railway lines were all incorporated. The Missouri was the first to get underway, and Erastus Wells drove the first car over the line to the terminus on 17th street, on July 4, 1859. That was the beginning of the Olive street line, one of St. Louis' greatest properties to day. Mr. Wells was President of the Company, and held a controlling interest until 1881, when he sold out to the present owners. He was the main spirit in and President of the Narrow Gauge Railroad to Florissant, which is now part of the St. Louis and Suburban. This interest he also sold out in 1881. At one time he was a Director in the Ohio and Mississippi Railroad, was President of the Accommodation Bank, a Director and Vice-President of the Commercial Bank, and was President of the Laclede Gas Light Company for many years. Although not a member of the Western Gas Association, Mr. Wells was much interested in its welfare, and it might be of interest to note that he presided at the banquet tendered the Association in the Southern Hotel, St. Louis, on the occasion of the 1884 meeting, an entertainment that largely resulted from his practical aid. From 1848 to 1869 Mr. Wells was a member of the St. Louis Municipal Assembly, and in 1866 he was instrumental in inaugurating the public system of water works, and laid the foundation for the present creditable financial condition of St. Louis. In the fall of 1868 he was elected to Congress, and served therein four consecutive terms, or until 1876, when he refused a renomination. He was a prominent factor in legislation intended to benefit the St. Louis district, a notable act especially in this connection, being his successful, albeit pertinacious struggle to secure the passage of the Eads jetty bill. He was also the pioneer in Congress for the movement to open up the Indian Territory. As a firm, reliable friend he had no peer. 'He never forgot a favor and never went back on a friend,' was what his political associates always could truthfully claim for him; even to his death many of his old-time friends were aided when necessity compelled them to ask his help. He was twice married; first in 1850, to a daughter of the Hon. John F. Henry, by whom he had two sons and one daughter, who survive him. His second wife, the widow of D. W. Bell, also survives. He was laid away to rest on Wednesday (the 4th inst.), the funeral taking place from his residence near Wells Station on the Suburban Railway."

ON the 11th inst., Mr. Marcus Smith, Secretary of the Wilkes Barre (Pa.) Gas Company, notified the residents that hereafter the selling rate in that city will be $1.20 per 1,000 cubic feet, gross, with a discount of 1 cent per 100 cubic feet when bills are paid on or before the 15th day of the month in which they are rendered.

THE New Home Sewing Machine Company, of Orange, Mass., has placed the contract with the Berlin Iron Bridge Company, of East Berlin, Conn., for a new foundry and tumbling room. The building, which is to be entirely of iron, will be 45 feet in width by 120 feet in length.

THE Street Laborers Union, of Boston, Mass, recently held a meeting, at which they passed resolutions denouncing the Boston Board of Aldermen for refusing to allow the Brookline Gas Company permission to open streets for the purpose of extending its distributing system.

THE Standard Gas Company has petitioned the Village Trustees of North Tonawanda for permission to increase the selling rate of the natural gas distributed by it to 25 cents per 1,000 cubic feet.

THE AMERICAN GAS LIGHT JOURNAL

EDITOR—Jos. R. Thomas, C.E.
ASST. EDITOR—T. J. Cunningham.
MANAGER—C. E. Sanderson.

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VENTILATION, SANITARY IMPROVEMENT,
AND GENERAL SCIENCE

MONDAY, OCTOBER 16, 1893.

The Market for Gas Securities.

Consolidated advanced to 131½ in the week, and the opening price to day (Friday) was 130 to 132, with a brisk inquiry for the shares, which leads one to believe that higher figures are to be made in it forthwith. With a fairly steady money market, Consolidated should advance rapidly, and if the conditions are at anything like normal for the next two months, the shares ought to reach 150. Mutual is steady and strong, and a like statement may be made in respect of Equitable. Standard preferred is inquired after, and 80 is bid for Northern, although we doubt if a bid of 90 would bring out any stock. The Brooklyn situation is as muddled as ever, with the prospect that this winter an application for a charter for a new Company, to be backed by some remarkably shrewd financiers, will be made to the Legislature. Looking over the field carefully, we think there is more safety in selling than in buying Brooklyn shares at the quoted prices. Chicago gas, after selling up to 61 and a fraction, opened to-day at 58¼ to 58½. Baltimore Consolidated moved up to 57⅞ to 58. Bay State common is worth 16, according to the market, whereas in our belief it is cheap at 20. Detroit bonds have moved up to 40 bid, and Laclede common is dull at 15¼ to 15½.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 WALL ST., NEW YORK CITY.

OCTOBER 16.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share. ☜

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	130	132
Central	500,000	50	90	95
" Scrip	220,000	—	—	100
Equitable	4,000,000	100	170	175
" Bonds	1,000,000	—	106	108
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	138	145
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	80	95
" Bonds	150,000	—	—	100
Richmond Co., S. I.	346,000	50	50	65
" Bonds	20,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	—	32
Preferred	5,000,000	100	60	65
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	—	105
Citizens	1,200,000	20	50	55
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co.	2,000,000	100	25	40
Bonds	1,000,000	—	—	—
Fulton Municipal	3,000,000	100	120	—
" Bonds	300,000		103	—
Peoples	1,000,000	10	—	75
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	98	100
Metropolitan	870,000	100	115	120
" Bonds (5's)	70,000	—	100	—
Nassau	1,000,000	25	140	—
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	125	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	—	77
2d " " "	3,000,000	1000	—	60
Bay State Gas Co.—				
Stock	5,000,000	50	16	—
Income Bonds	2,000,000	1000	40	—
Buffalo Mutual, N. Y.	750,000	100	110	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
Chicago Gas Company.	25,000,000	100	58¼	58½
Chicago Gas Light. & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	81⅛	81½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Consumers Gas Light Co., Jersey City	2,000,000	100	—	30
Bonds	600,000	1000	—	85
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal			—	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt	11,000,000	100	57⅞	58¼
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
1st Mortgage			40	60
East River Gas Co., Long Island City	1,000,000	100	—	—
Bonds	500,000	100	86	87
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	190	200
Laclede Gas Light Co., St. Louis, Mo.—				
Common Stock	7,500,000	100	15¼	15½
Preferred "	2,500,000	100	58	62
Bonds	9,034,400	1000	76½	77
Louisville, Ky	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208

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In addition to a full assortment of Volumetric Governors, etc., I am now making **MERCURY PRESSURE GOVERNORS** of all the usual sizes, adapted to use upon *Gas Stoves, Furnaces, and Meters*. The same careful attention to details of design and workmanship which has established the reputation of **WILDER'S VOLUMETRIC GOVERNORS** will be given to the new line. They have been thoroughly tested in many places during the past year, and have given entire satisfaction. The price is very low, and but for a complete system of machinery adapted to this work, it would be impossible to sell them at the price. I hope for large orders, as they become known, in consequence of the low price and good quality.

CHAPMAN VALVE MANUFACTURING CO.,

MANUFACTURERS OF

Valves and Gates for Gas, Ammonia, Water, Etc.

Also, Gate Fire Hydrants with and without Independent Nozzle Valve. All Work Guaranteed.

Works & Gen'l Office, Indian Orchard, Mass. Treasurer's Office, 72 Kilby & 112 Milk Sts., Boston, Mass.
Chicago Office, 24 West Lake St. New York Office, 28 Platt St.

To Gas Companies.

We make to order **CAP BURNERS** to burn any amount under a stated pressure. Send for samples.

Also, SERVICE CLEANERS, DRIP PUMPS, and STREET MAIN PROVING APPARATUS.

C. A. GEFRORER,

248 N. 8th St., Phila., Pa.

GASHOLDER PAINT.

Use Only

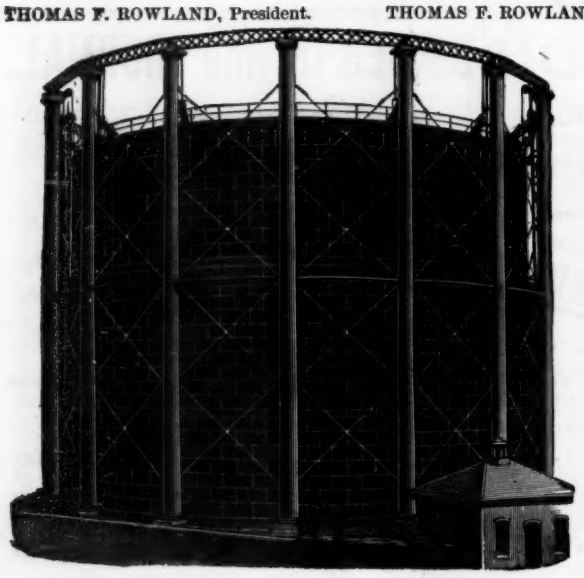
THE GOVERNMENT WATERPROOF PAINT.

Proof against Ammonia, and Absolutely Waterproof. Send for Prices and Particulars.

THE GOVERNMENT WATERPROOF PAINT CO., 104 High Street. Boston, Mass.

The Continental Iron Works

THOMAS F. ROWLAND, President. THOMAS F. ROWLAND, Jr., Secretary & Treasurer. WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.



BROOKLYN, N. Y.

TAKE EAST TENTH OR TWENTY-THIRD STREET FERRIES FROM NEW YORK TO GREENPOINT.

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GAS HOLDERS.

Single and Multiple Section Gas Holders a Specialty.

Wrought Iron Gas Holder Tanks.

BENCH CASTINGS, RETORT LIDS.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, Etc., Etc.

SELF-SEALING RETORT MOUTHPIECES & LIDS.

For Round, Oval, or "D" Retorts.

Reliable Gas Heaters, Parlor Grates and Radiators.

Three Distinct Lines.

Sixty Different Styles.

Ranging in Price from

$5.00 to $30.00.

Send for 1894 Catalogue of Heating Stoves.

New Designs and

Improvements for 1894.

The Largest and Most Complete Line ever Manufactured Under one Name.

The SCHNEIDER & TRENKAMP CO.,

Sole Manufacturers of Reliable Gas Heaters. **479-501 Case Ave., Cleveland, Ohio.**

Jewel Gas Heating Stoves
For 1893-94.

Send for Catalog of the Most Artistic Line of Heaters on the Market.

The New Double Reflector is Worthy of Attention.

22 Styles. Prices from $4.50 to $12.

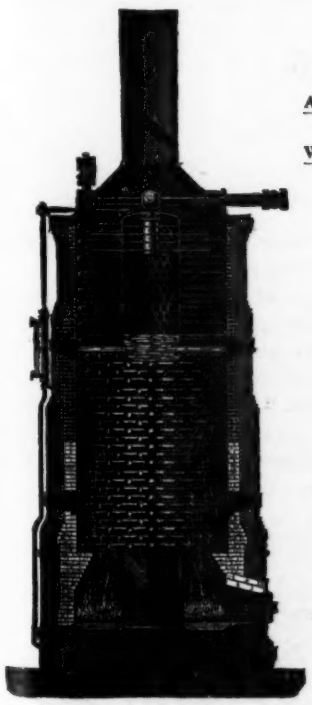
GEORGE M. CLARK & COMPANY,

MAKERS,

149-161 Superior St., Chicago

The HAZELTON BOILER Frequently Called The PORCUPINE BOILER

Patented in America and Abroad.



100,000 HORSE POWER

of this Justly Celebrated Water-Tube Boiler in Successful Operation in all the Principal Industries.

An Unparalelled Record, of Over Twelve Years, for Economy, Durability, Safety, and Efficiency.

A Common-Sense High-Pressure Boiler made in a Superior Manner.

We Solicit for it the Critical Examination of the Mechanical Profession and the Steam-Using Public.

THE HIGHEST STANDARD OF EXCELLENCE.

Standard Sizes, 50 H.P. to 500 H.P.

THREE REGISTERED
THE HAZELTON BOILER.

THE PORCUPINE BOILER.
TRADE MARKS.

Special Sectional Boilers For Export.

The only Genuine Hazelton or Porcupine Boilers bear our Three Registered Trade Marks.

∴ BEWARE OF IMITATIONS. ∴

This Company is prepared to Manufacture and Furnish Plants of Boilers of any desired capacity, and will forward proposals and other information on application. All imitations of the substantial features of this Boiler are infringements, and will be prosecuted to the full extent of the law.

THE HAZELTON BOILER CO.,

Sole Proprietors and Manufacturers, NEW YORK, U. S. A.

Cable Address, "PAILA," NEW YORK.

WRITE FOR ILLUSTRATED CATALOGUE. Correspondence Solicited.

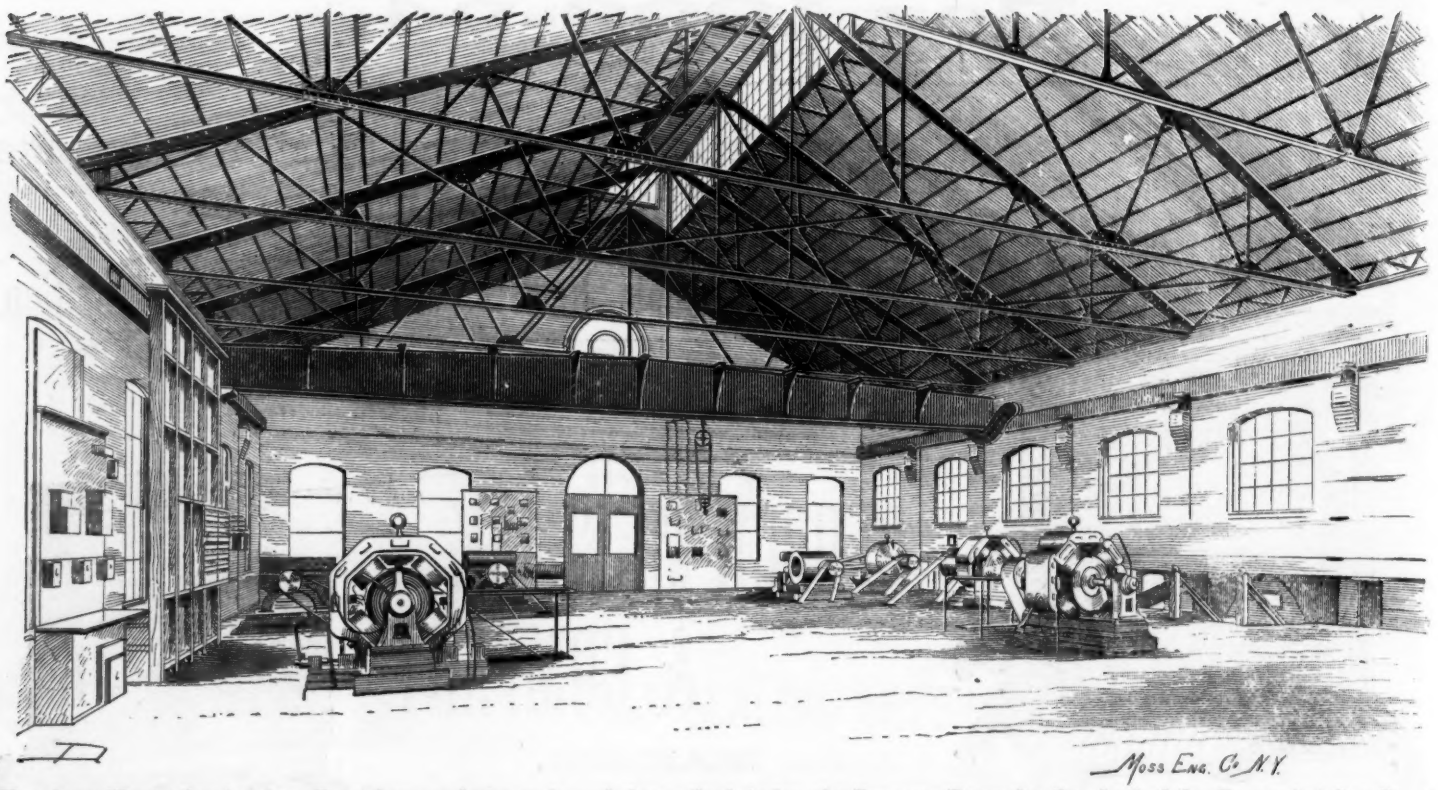
Long Distance Telephone, 1229-18th St., New York.

This Boiler is producing unequaled results in the works of most of the principal Gas Co.'s of the U.S., and in similar plants in Foreign Countries

NOT CONNECTED WITH ANY OTHER CONCERN IN THE UNITED STATES

CHAS. M. JARVIS, Prest. & Chief Engineer. BURR K. FIELD, Vice-President FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary.

THE BERLIN IRON BRIDGE CO.



The above illustration is taken direct from a photograph, and shows the interior of a Dynamo Room for the plant of the Pawtucket Gas Co., at Pawtucket, R. I. This Dynamo Room is 60 feet in width by 150 feet in length, the Roof and Traveling Crane for which were furnished by us. The roof is constructed entirely of iron, covered with our Patent Anti-Condensation Corrugated Iron Roof Covering, which we guarantee as fireproof, and will not drip in the coldest weather.

Write for Illustrated Catalogue.

Office and Works, No. 6 Railroad Avenue, East Berlin, Conn.

HIGH CANDLE POWER

FROM

GAS.

MR. WALTON CLARK, Assistant General Superintendent, United Gas Improvement Co.:

Dear Sir—In accordance with your request, I have made several ests of the new Welsbach mantel (called No. 169) for candle power and efficiency, and I herewith submit the following results:

	Candle Power.	Pressure.	Gas Consumed.	C.P. per Cu. Ft.
Average of Test No. 1,	67.05	.95 in.	2.6	25.70
" " No. 2,	63.86	1.00 in.	2.86	22.30
" " No. 3,	72.50	2.1 in.	2.87	25.26

The above averages are the results of trials on three different occasions, and in each case the mantles tested were made from a different lot of fluid.

The mantles used in the above tests were selected at random, and all had been dipped in kristaline and dried ready for shipment.

It is quite possible that better results could have been obtained by manipulating and readjusting the position of the mantles on the galleries, and also by waiting a longer period after burning off the kristaline; but I considered such fine adjustment undesirable in determining the commercial candle power.

These tests were made on a bar photometer against a regular Edgerton standard slit. The candle power of the slit was 6.18, and the gas used was Gloucester City water gas, 26 candle power.

Very truly yours,
(Signed) C. H. PAGE, JR., M.E.

WE ARE NOW PREPARED TO FILL ALL ORDERS PROMPTLY FOR

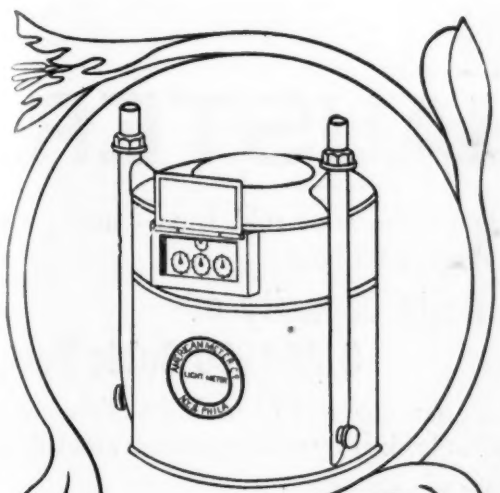
HIGH CANDLE POWER WELSBACH LIGHTS.

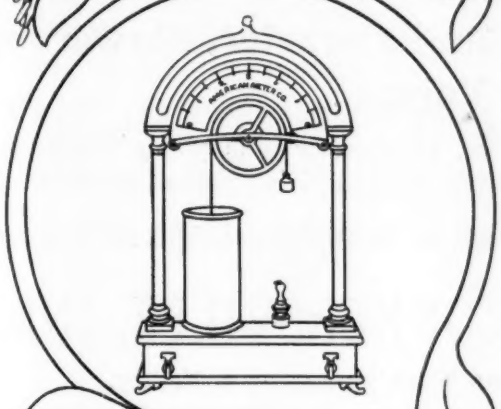
Gloucester, N. J. WELSBACH LIGHT CO.

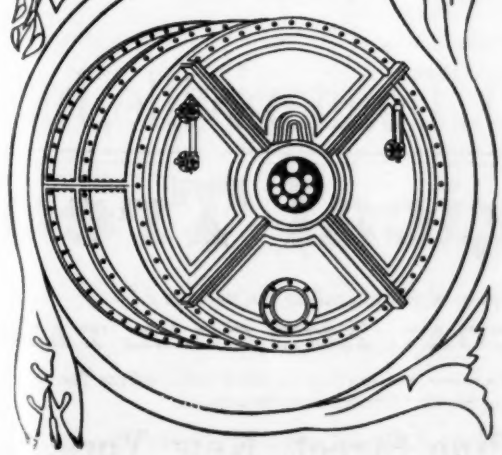
NEWBIGGING'S HANDBOOK FOR GAS ENGINEERS AND MANAGERS.

The present (the fifth) edition marks an important advance on those that have gone before. Considerable additions have been made to the text and much of it has been rewritten and otherwise improved. Price, cloth, $6.

A. M. CALLENDER & CO., 32 Pine St. N. Y







AMERICAN METER CO.

ESTABLISHED 1834. INCORPORATED 1863.

NEW YORK and PHILADELPHIA.

CHICAGO, CINCINNATI,

ST. LOUIS, SAN FRANCISCO.

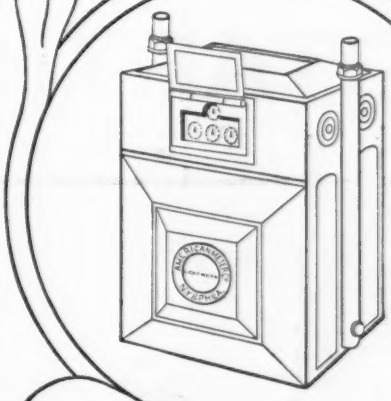
PUBLIC LIGHTING TABLE.

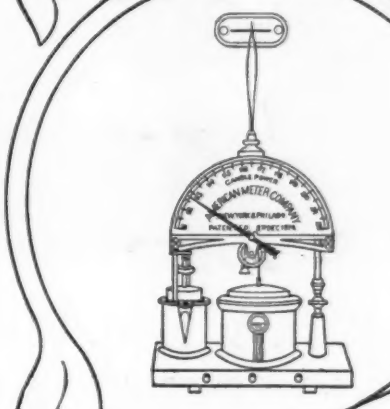
OCTOBER, 1893.

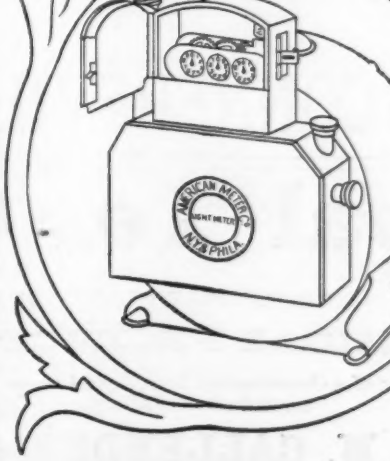
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M	A.M.
Sun.	1	6.10 PM	10.40 PM	5.30	5.00
Mon.	2	6.10 LQ	11.40	5.30	5.00
Tue.	3	6.10	1.00 AM	5.30	5.00
Wed.	4	6.10	2.10	5.30	5.00
Thu.	5	6.10	3.20	5.30	5.00
Fri.	6	6.10	5.00	5.30	5.00
Sat.	7	6.00	5.00	5.30	5.00
Sun.	8	6.00	5.00	5.20	5.10
Mon.	9	6.00 NM	5.00	5.20	5.10
Tue.	10	6.00	5.10	5.20	5.10
Wed.	11	6.00	5.10	5.20	5.10
Thu.	12	6.00	5.10	5.20	5.10
Fri.	13	6.00	5.10	5.20	5.10
Sat.	14	6.50	5.10	5.20	5.10
Sun.	15	7.40	5.10	5.10	5.20
Mon.	16	8.40	5.10	5.10	5.20
Tue.	17	9.40 FQ	5.10	5.10	5.20
Wed.	18	10.40	5.10	5.10	5.20
Thu.	19	11.50	5.10	5.10	5.20
Fri.	20	12.50 AM	5.20	5.10	5.20
Sat.	21	2.00	5.20	5.10	5.20
Sun.	22	3.10	5.20	5.00	5.30
Mon.	23	No L	No L.	5.00	5.30
Tue.	24	No L	No L.	5.00	5.30
Wed.	25	No L FM	No L.	5.00	5.30
Thu.	26	5.30 PM	6.50 PM	5.00	5.30
Fri.	27	5.30	7.30	5.00	5.30
Sat.	28	5.30	8.30	5.00	5.30
Sun.	29	5.30	9.30	4.45	5.35
Mon.	30	5.30	10.50	4.45	5.35
Tue.	31	5.30 LQ	12.00	4.45	5.35

TOTAL HOURS LIGHTING DURING 1893.

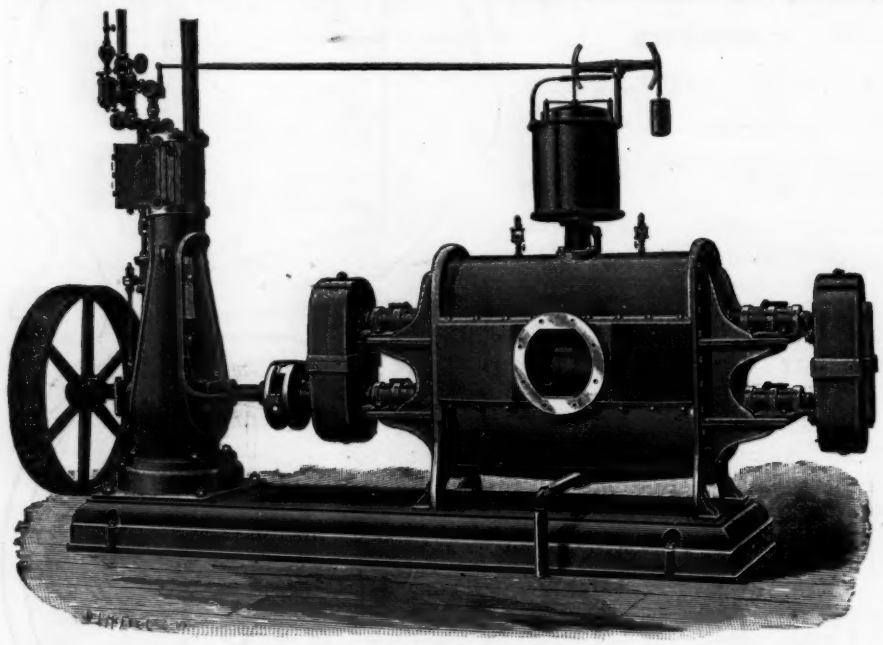
By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January...	217.30	January...	423.20
February..	200.30	February..	355.25
March	177.50	March	355.35
April.....	160.30	April.....	298.50
May.....	149.00	May.....	264.50
June.....	140.30	June.....	234.25
July.....	143.40	July.....	243.45
August....	154.50	August....	280.25
September.	171.50	September.	321.15
October....	202.20	October....	374.30
November.	221.30	November.	401.40
December.	248.50	December.	433.45
Total..	2188.50	Total..	3987.45







ROOTS' ROTARY GAS EXHAUSTER.



Our Exhausters sold from January 1st to August 1st have

A Daily Capacity of 31,160,000 Cubic Feet.

Our guarantee as to Durability, Efficiency, etc., is backed by our reputation and thirty years of experience.

Are You in the Market for an Exhauster, Blower or Valves?

If so, let us hear from you. Thousands now in use and giving perfect satisfaction.

Send for Descriptive Catalogue and Prices.

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WE GUARANTEE

THE BEST DESIGNED, . .
THE BEST CONSTRUCTED,
THE SMOOTHEST RUNNING,
THE MOST ECONOMICAL, .
THE MOST EFFICIENT . .

GAS EXHAUSTER

NOW ON THE MARKET.

The attention of Gas Engineers and Manufacturers is respectfully invited to our new

CYCLOIDAL EXHAUSTER,

the internal operating parts of which consist of two Revolvers, each p'aned accurately on cycloidal lines, the only Exhauster so constructed.

SIMPLICITY ✻ EFFICIENCY ✻ DURABILITY.

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Coal Tar Genealogical Tree

MR. T. VINER CLARKE, of London, Eng., having compiled a novel Chart or Map illustrating the various

CHEMICAL PRODUCTS DERIVED FROM COAL AND COAL TAR,

In the form of a Genealogical Tree, including all the products discovered to date (the total number amounting to near 700), offers for sale a limited number of copies in Colors, mounted on Linen, with Rollers. Price, $3.50. Orders may be sent to

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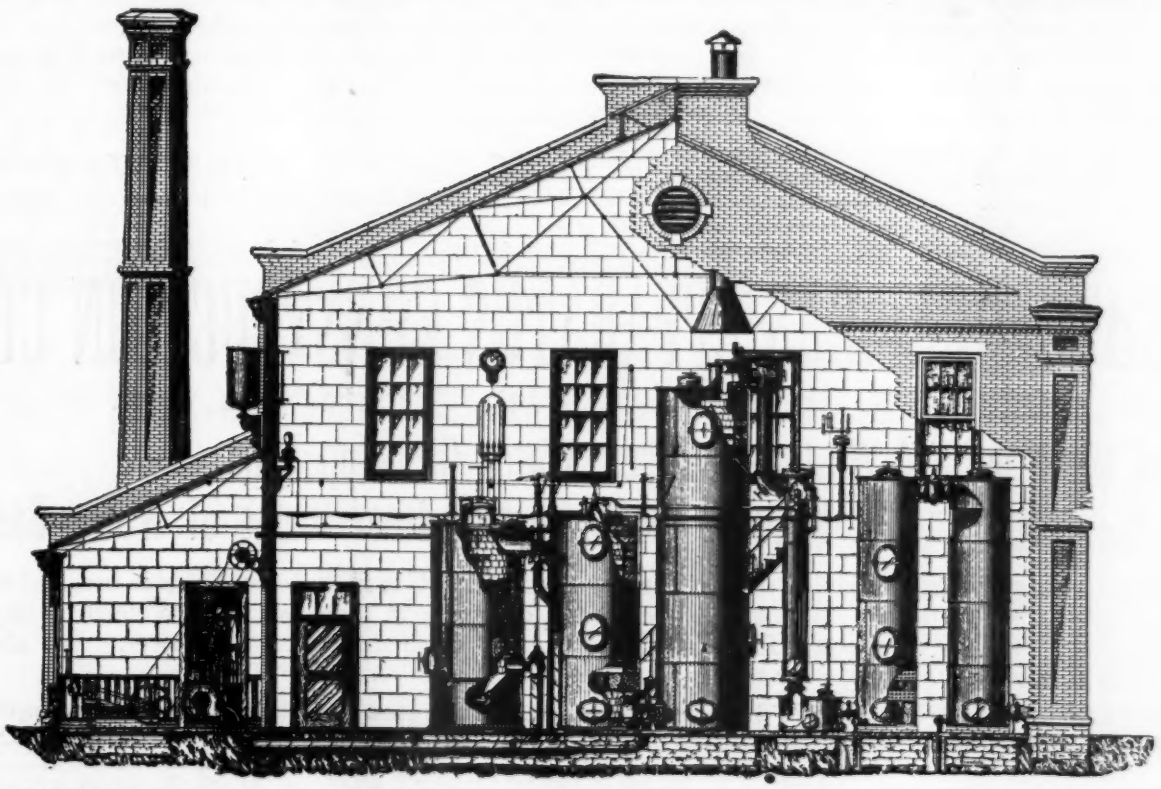
Inquiries from any part of the United States should be addressed to the Philadelphia Office.

BUILDERS OF

THE STANDARD LOWE WATER GAS APPARATUS.



Standard "Double Superheater" Lowe Apparatus, designed for the use of Naphtha, Crude Oil, or "Distillates."

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Water Gas Plants, either independent or auxiliary to Coal Gas Works, erected to meet any conditions. Apparatus designed to use any grade of Oil, and Anthracite Coal, or Gas House or Oven Coke.

PAMPHLETS, PLANS AND ESTIMATES FURNISHED UPON APPLICATION.

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BY THE

WESTERN GAS CONSTRUCTION CO.,

Of Fort Wayne, Ind.

The number of Water Gas Plants built by us this year fully testify to the merit of our **Improved** style of **Lowe Water Gas Apparatus.** Results obtained in the various sizes of our plants, up to over 900,000 cubic feet capacity per diem, show what can be attained in a well designed machine. We are prepared to **Guarantee Results,** as well as first-class construction. We build apparatus ranging in capacity from 50,000 cubic feet to 1,000,000 cubic feet per diem, and larger when required.

Our shop facilities are unexcelled, and enable us to quote prices which will prove interesting. The plants in operation demonstrate we have the **Experience** necessary to build Water Gas Apparatus on **Scientific** as well as **Practical** principles, and consequently **Build them Well.** Hence we don't hesitate to **Guarantee the Results.** We not only believe in "Water Gas on its merits," but also in building the apparatus at a price that will not only prove it a desirable investment as to the first cost, but produce results that will put the balance on the right side of your ledger.

There are three essential features in our design which we carefully considered as **Absolute Requirements:**

Durability, neatness, and compactness of the machine.

Minimum labor requirements for operation, and

Minimum amount of material required for results.

And when we add to this a minimum cost of a **Strictly First-Class Apparatus,** can you afford to be without it? If not, write us, and we shall take pleasure in proving our statements to be facts.

Also remember we are not exclusively building Water Gas Apparatus, but if you require **Any Apparatus** for **Coal or Water Gas** and want the latest and best designs, write us for prices, or we will execute carefully your own designs if desired, as we believe in giving you exactly what you want.

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Owners of the Merrifield-Westcott-Pearson Water Gas Apparatus, and Builders of the Lowe and other forms of Water Gas Plants.

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For Continuous Records of

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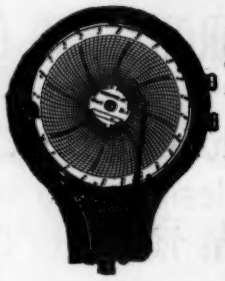

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Accurate in Operation,
Low in Price,
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Waterbury, Conn.

See our Exhibit at World's Fair.
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Special Trays for Iron Sponge or Oxide of Iron.

CHURCH'S TRAYS a Specialty.

Reversible, Strongest, Most Durable, Most Easily Repaired.

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We also make the Cheapest and Strongest
REVERSIBLE BOLTED TRAYS IN THE MARKET.
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Guaranteed Estimates of Cost of Gas in Holder Furnished upon Application.

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AUTOMATIC GOVERNOR. OVER FOUR HUNDRED NOW IN USE! NO WORKS COMPLETE WITHOUT IT! WILL PAY FOR ITSELF WITHIN A YEAR! ITS SERVICE SECURES PERFECT DISTRIBUTION! REDUCES LEAKAGE TO MINIMUM, and BENEFITS THE COMPANY and CONSUMER ALIKE! IT IS THE ONLY RECOGNIZED AUTOMATIC GOVERNOR IN THE WORLD!

STEAM JET EXHAUSTER. Designed particularly for small works. Combines Exhaust Tube, Steam Governor, Gas Compensator and Bye-Pass Valves in the most compact form possible. Occupies but little space; uses very little steam; saves formation of carbon in retorts; increases yield 10 to 15 per cent. No works too small to use them profitably.

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Successors to WILBRAHAM BROS.,

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THE HUNTOON GAS GOVERNOR,

The Best Governor in the Market for Rotary or Steam Jet Exhausters.

Wilbraham Gas Exhausters,

BAKER ROTARY PRESSURE BLOWERS,

And Rotary Piston Pumps.

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Acts immediately, and more efficiently than any other purifying agent now in use.

Greenpoint Chemical Works.

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For Gas Purification

Is a superior natural Hydrated Oxide of Iron. Will give a higher purification per bushel than any other material. We ship the pure Oxide of Iron, containing no sawdust, thus effecting a saving in freight, leaving the consumer to furnish the diluent at a nominal cost. It is now used by the largest gas companies in the West.

Full information, with references to many users, and prices delivered in any locality, furnished on application to

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GAS COALS. CANNEL COALS. COKE CRUSHERS.

JAMES D. PERKINS. **PERKINS & CO.,** F. SEAVERNS.

228 & 229 Produce Exchange, New York.

Cable Address, "PERKINS, NEW YORK." Post Office Box 3695, New York.

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OCEAN MINE YOUGHIOGHENY GAS COAL.

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ALSO, SOLE SHIPPERS OF THE

Old Kentucky Shale, From Kentucky.

TRADE **O. K. SHALE.** MARK.

THE MOST VALUABLE GAS ENRICHER NOW AVAILABLE IN ANY DESIRED QUANTITY.

S. CALVERT FORD, Government Inspector at Washington, pronounces this Shale

"ONE OF THE BEST GAS ENRICHERS THAT HAS BEEN OFFERED TO THE TRADE."

He reports it as giving:

12,553 Cubic Feet of 50-Candle Gas,
or 10,460 Cubic Feet of 60-Candle Gas,

AN EQUIVALENT OF 627,650 CANDLE FEET,

And 808 Pounds of Merchantable Coke.

Single Carloads or more delivered at any required point in the United States or Canada.

Cargo Shipments from NEW YORK, PHILA., BALTIMORE and NEWPORT NEWS.

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Proprietors of the **BATHVILLE COLLIERIES** (which produce the celebrated **BOGHEAD CANNEL**), Shields, Shieldmuir, Drumpeller, and other Collieries. This Firm offer

STANDARD CANNELS,

Unequaled as Gas Enrichers.

Analyses, prices, and all further information furnished on application to

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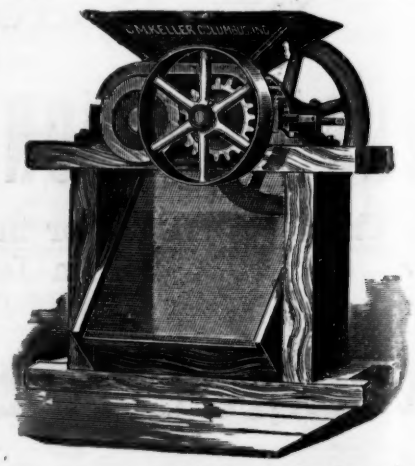

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SIMPLE, STRONG, AND DURABLE.

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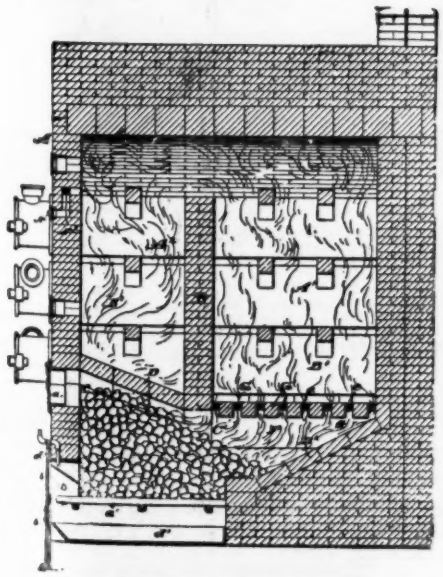

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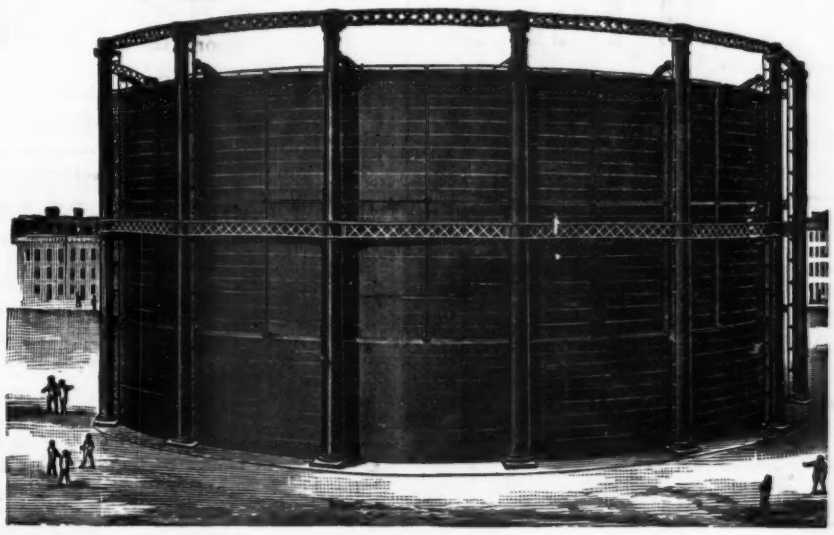

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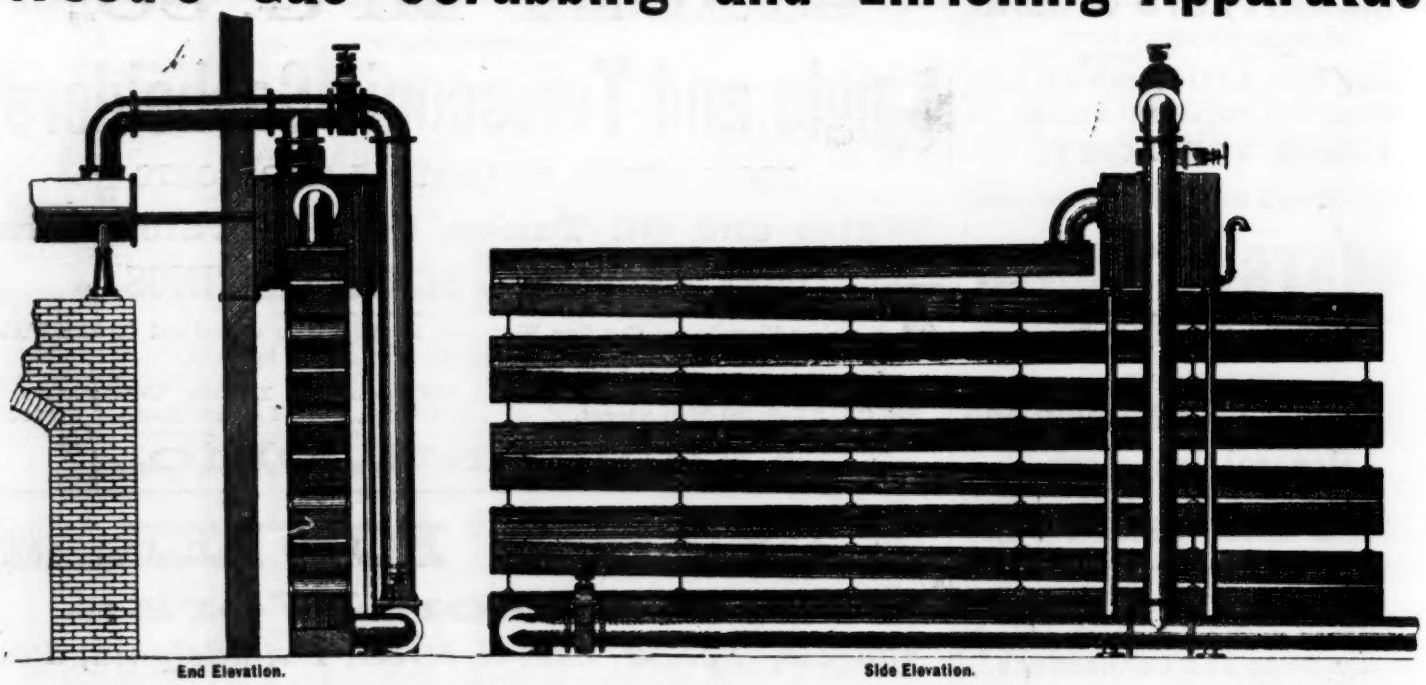

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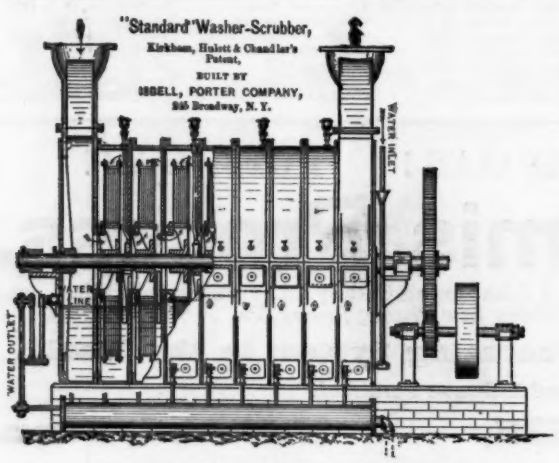

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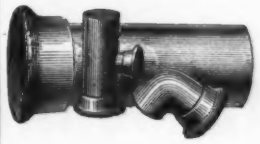

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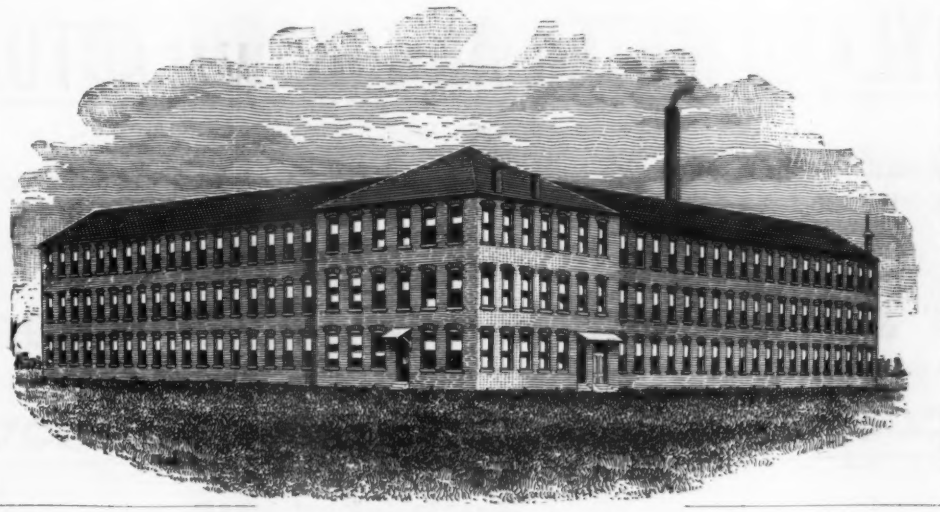

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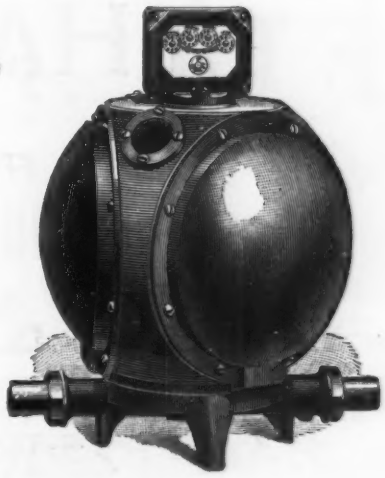

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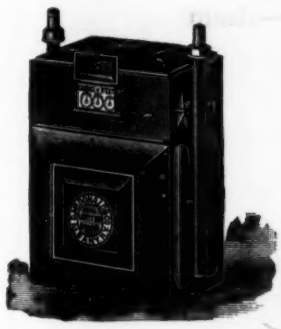
REPAIRING DEPARTMENT.—We employ a special force of skilled workmen repairing meters of **all makers.**



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The superior feature of this meter is that it avoids the danger of displacement of the valves, and consequent loss of gas, either in shipping, handling, or by dishonest consumers.

To designate from the regular Glover Meter, also made by us, we style the above the HEARNE-GLOVER Meter.

It is worth your consideration.

Full descriptive circular sent on application

$10,500,000

Is the estimated value of Gas consumed per year by

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NOW in use . . . . . .

To what extent does **Your Company** participate in this amount?

If you have not reached out for your share, it is time **now** to do so—for many good reasons:

1st. Because rates on Electric current are on the increase.

2d. Because improvements in our "Otto" Gas Engines have been wonderful and numerous, and have cheapened their cost.

3d. Because prices for Gas are lower than ever before.

4th. Because you can therefore make a price for Fuel Gas sufficiently low to leave you master of the situation as regards competing systems of power—steam or electricity.

WILL IT PAY?

Mr. Thomas Fletcher, well known in the Gas Industry, gives his opinion on this question as follows:

"It is essential for economical working, and consequent low prices, that the plant as a whole shall be utilized as far as possible for the whole 24 hours every day, summer and winter alike. If this ideal state of things could be attained, about three or four times the output could be sold with practically no addition to the capital expenditure, *and consequently the profits would be increased to four or five times the present amount*, or even more, as the staff expenses would not rise in proportion, an account of £25 being quite as easy to deal with as one of £5, and requiring no additional office work. Instead of being the best customers, *shopkeepers* and *owners of large works* are really *the worst* the gas industry has to deal with, spite of the large total amount, and the reason is simple. The consumption is enormous during two or three hours in winter, entailing the necessity of enormous holders and very large distributing plant, all of which is absolutely idle during the summer. THE BEST OF ALL CUSTOMERS ARE THOSE WHO USE GAS FOR ENGINES, workshop and industrial purposes, as these will use a steady supply for about ten hours daily, winter and summer alike, and *these are the users worthy of the greatest consideration.* Next to these come the users of gas cooking appliances and gas fires, they also being practically steady users for long hours both in the winter and summer. Domestic lighting does not come out anything so favorably, as the consumption in the winter averages over double that in the summer, entailing the loss on idle plant during a large portion of the year. The dream of the gas engineer is a large summer and 'day gas' consumption, and on *these depend large profits and economical working.*"

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